VOCATIONAL EDUCATION[1]

The problem of vocational education which has attracted increasing attention in the United States since the beginning of the twentieth century is now prominently before Philippine educators. To the layman, just what is meant by this sudden renewed interest in vocational education is not exactly understood. The words ring with a new meaning, for have we not already law schools, medical schools, trade schools, agricultural schools, nurses' training schools, and others which are in effect vocational schools? Must it be that these are inadequate to meet the present needs of society and more are necessary for other vocations, or is it that the present tendencies in our public school system need redirection towards more productive lines?

The advancing needs of society are taking into the schools a large amount of the vocational work that used to be handled in the shops, farm, and other occupational centers. The training of artisans and mechanics is now being assumed more and more by regular and special trade schools. People are also demanding that future farmers be trained in schools. Apparently the product obtained through the apprenticeship system is no longer adequate for the more exacting or perhaps greater needs of present day society. But the vocational school which supplants the shop and the farm as a training ground must prove its worth by demonstrating its ability to produce human products of qualifications superior to those produced by the method they seek to supplant.

The success obtained by specialized schools in the older vocations serves as the guiding light that imparts confidence in the teacher of occupations now gradually being brought under school control. No educated man, for example, will take seriously the physician who did not obtain his training in a medical school, or a lawyer who was not trained in a law school. Yet it was not so many years ago that we depended on men without special training for the service these two professions render us now. We are no longer content to have our sick cared for except by the hands of school trained nurses, and in time we may not wear clothes other than those sewed by "academical cutters."

The problem of the agricultural teacher is by no means an easy one. Even in America, where the greatest effort has been made to establish agricultural schools, it is doubted by many whether they have justified the investment made in them in the training of actual farmers. There seems

[1] General contribution from the College of Agriculture No. 204.

to be no question as to the success of the agricultural college in producing scientists, or specialists in some particular activity bearing directly on agriculture, such as entomologists, plant breeders, nutrition men, drainage specialists, marketing specialists, soil and fertilizer experts, and the like. Is it not likely that the knowledge required in agriculture is of such a varied nature, and so much under control of natural phenomena that an individual alone finds himself at a tremendous disadvantage in facing such numerous problems? Perhaps a radical readjustment of the manner of operation of the farm will be necessary in the future wherein the common farmer, like the toiler in a large factory, becomes a mere part in a big organization, capable of performing his allotted task so long as conditions are favorable, and depending to a large extent on the specialist to make conditions favorable for his work. This method of organization is already evident in some states of America wherein there is a well established system of experiment stations, and in occasional planter associations such as the Hawaiian Sugar Planters' Association, entities which look after the greater problems of the farmers they seek to serve.

When this system of farm organization becomes more widely acceptable, then the agricultural schools will have their problems of vocational training circumscribed within limits more in consonance with man's natural limitations.

B. M. Gonzalez,
Acting Dean, College of Agriculture.

Success means nothing more or less than doing the work you are suited for to the best of your ability. It means getting fitted into your proper place in life's machinery, doing each day's work honestly, living cleanly and thriftily, and trying each day to improve upon the work of the day before.

—*The Kalends* (Williams and Wilkins Co.).

Education is a better safeguard of liberty than a standing army. If we retrench the wages of the schoolmaster, we must raise those of the recruiting sergeant.—Edward Everett.

—*Journal of Education* (Wisconsin)

A REPORT ON AN AGRICULTURAL INVESTIGATION TRIP TO JAVA, FEDERATED MALAY STATES, AND BORNEO.[1]

NEMESIO B. MENDIOLA

Of the Department of Agronomy
Fellow, International Education Board of New York

WITH FIVE TEXT FIGURES

I received my appointment as a Fellow of the International Education Board of New York in July, 1926. The Board of Regents of the University of the Philippines granted me permission to accept this fellowship and approved an allowance to come from the funds of the University to be paid to me on the same basis as the allowance given University men who had been appointed fellows of the Rockefeller Foundation.

I sailed from Manila on October 16, 1926, arriving in Zamboanga four days later. While waiting in this town for a steamer by which I could reach Singapore, I visited the San Ramon Penal Farm and important coconut and rubber plantations in Basilan Island. On November 2, I sailed on the *S. S. Marudu* of the Straits Steamship Company for Singapore *via* Jolo and British Borneo ports. The steamer stayed in Jolo the greater part of a day. This gave me the opportunity of visiting, through the courtesy of Governor Moore, the Inulin Estate, where Hevea rubber trees supposed to be the oldest in Jolo are to be found. The Governor showed me the work which he was doing in planting mango, rubber, and other trees along the provincial road. Ex-governor Agustin Alvarez of Zamboanga took me to the Indanan Farm School in Jolo where the principal, Captain Link, showed me the different phases of the work of this school including the school printing press. The most important cities of British Borneo I visited, from the standpoint of my work, are Sandakan and Jesselton. In Sandakan I met Mr. Juvencio Leaño of our College and several alumni of the Philippine School of Forestry who are all employed by the British North Borneo Government. Mr. Agustin Collado, formerly with the Philippine Bureau of Forestry, was in charge of the Forestry office in Sandakan. He showed me the exhibits in the Forestry Museum and accompanied me to several rubber estates and to the Agricultural Experimental Garden, which is under the supervision of Mr. Leaño. When I arrived in Jesselton, I was met by Mr. Felix Telado, another alumnus of our College, who is in charge of the agricultural extension work of the government in that part of Borneo. With him I called on Doctor Bateson who is the botanist of the British North Borneo Government and visited several rubber estates in this region.

[1] Experiment Station contribution No. 527. Received for publication March 23, 1928.

Singapore was reached on November 14 and on the following day, I boarded the *S. S. Tasman* of the Konninklijke Paketvaart Maatschappij, for Java. I arrived in Batavia on November 17. The following morning, I took the train for Buitenzorg, arriving at this city after a little more than one hour's journey. I reported for work at once to Doctor P. J. S. Cramer, director of the General Experiment Station, and to Mr. L. Koch, of the Annual Crops Section of the same Station, who was my immediate sponsor.

On December 7, 1926, Doctor Cramer sent the following communication to Dean Baker in which was outlined the work I was to do while in Java:

Buitenzorg, 7 December, 1926.
Dean Chas. F. Baker
College of Agriculture
Los Baños—Philippine Islands

Dear Dean Baker,

Referring to my letter of May 7th, No. 561/26 A.P., I have the pleasure to send you a plan of the subjects Mr. Koch and I thought would be good for Dr. Mendiola to study here.

SUBJECT

1. Organization of the General Experiment Station at Buitenzorg.
2. Working of the Section for plant breeding with annual (Mr. Koch) and perannual crops (Mr. de Veer).
3. Methods now used for breeding rice, corn, cassava and coconuts, including the way to register data.
4. Working of the experiment stations for rubber (Buitenzorg), tobacco (Klaten) and sugar cane (Pasoeroean).

As you will see a large part of the work will have to be done in Buitenzorg, but, as the breeding of tobacco and sugar cane is done in Middle–and East Java, Dr. Mendiola will have to go there to study these subjects.

Though not actually part of the work, I thought a short visit to the Government coffee-breeding-garden at Bangelan (East-Java) would also be very instructive, as this garden is a good example of our commercial seed production of coffee varieties.

With kind regards,
Sincerely yours,
(W.g.) P. J. S. Cramer,
Director, General Experiment Sta.,
Department of Agriculture,
Industry and Commerce.

At the request of Doctor Cramer, a brief report on my work for the period, November 17 to January 15, was submitted to my advisers on January 15. A copy of this report, I learned subsequently, was forwarded to Dr. H. L. Russell, the Dean of the College of Agriculture at Madison, Wisconsin. Later, I sent a copy to the Director of the European Office of the International Education Board at Paris. Still later, a communication from Dean Baker gave the information that Dean Russell forwarded a copy of the report to the International Education Board Office at New York.

Besides carrying my work in the section under Mr. Koch and in that for perennial crops of the General Experiment Station during the period of my fellowship following January 15, 1927, I did the following:

In April I visited the following Experiment Stations: Sugar Cane Experiment Station at Pasoeroean and its Cane Breeding Garden at Blambangan; the Fruit Extension Garden in Pasoeroean; the Experiment Station for Coffee and Rubber at Malang; the Government Coffee Estate at Bangelan; and the Tobacco Station at Klaten. Still later, I visited the Cinchona Experiment Station at Tjinjiroean and the Exposition at Bandoeng.

Before leaving Java for the Federated Malay States in August, I conferred with the staff of the Experiment Station for Tea and of the Division of Agriculture of the Department of Agriculture, Commerce, and Industry and visited its large fruit garden at Pasar Mingoe.

While waiting for boat connections in Singapore, I visited one of the largest pineapple canneries in that city. In the Federated Malay States I visited the departments of Agriculture and of Forestry in Kuala Lumpur, including the Public Garden and the Experiment Station at Serdang, Langor.

FACILITIES FOR FOREIGN INVESTIGATORS AND DIFFICULTIES THEY MEET

The work of different agricultural experiment stations in Java and Sumatra is bound to attract there an increasing number of technical men from the Philippines. With the thought that they may prove helpful to such visitors I give the following suggestions:

Language preparation. It is not essential that a technical visiting worker in Java have a speaking knowledge of the Dutch language. The Dutch scientists in Java speak English and German and frequently other languages. The men older in the service speak the Malay dialects. These, they are forced to learn, for they have to deal with native subordinates and laborers who do not understand Dutch. Many of the Dutch scientists in Java are graduates of the College of Agriculture at Wageningen, Holland, where, I was informed, English, German, and French are required.

Location of main offices and laboratories. The offices and laboratories of the Department of Agriculture, Commerce, and Industry of the Dutch East Indies are grouped together on a beautiful site at Buitenzorg in and outside the famous Botanical Garden. The hotels are a stone's throw from this place. In fact one of the hotels and the building housing the offices of the Forestry Division stand side by side. The Buitenzorg Railroad Station is just about five minutes walk from the grounds of the Department of Agriculture and of its different divisions.

The private experiment stations, except the offices of the General Rubber Experiment Station and the Station for Tea, are all outside Buitenzorg but all can be reached by railroad trains and motor cars. Only the Coffee Estate of the Government at Bangelan, Residency Pasoeroean, is comparatively difficult to reach. The road leading from the nearest railroad station to this estate may be reached by motor car and it is advised to use a Ford car if one does not want to ride in the equivalent of a Philippine *carretela.*

The train service in Java is excellent and a complete guide book is obtainable at any of the larger stations. A little Malay, such as can be picked up readily, is necessary to avoid misunderstandings with railroad employees and with coolies. One who stays several months and hires servants learns the dialects faster. Many words in the Filipino dialects are found in the Malay as spoken in Java.

The library of the Department of Agriculture. The library of the Department of Agriculture is located near the main offices of the experiment stations. It has 130,000 volumes and receives about 600 different publications. It publishes every year a list of publications received both under subscription or under exchange. A practice worthy of note is that one day each month each technical member of the Department Staff is furnished with available current publications in this line. The librarian sends the list in with the accompanying publications checked to the station member for signature. Then after the latter is through with them he sends them back to the library and the publications are again available for others. In this way one is kept posted quite easily on the current work along his line. The Department of Agriculture has issued a complete list of all its publications for the period ending December, 1926, and this list should prove very useful to one who desires to study the research work in the Netherlands Indies.

Publications in Dutch. The results of investigations and research in the Netherlands Indies are published, generally in the Dutch language, in Holland or in Java. Experimental results of more international importance are sometimes published in English or with English summaries. Still other results are published in German. For extension work some are published in the dialects.

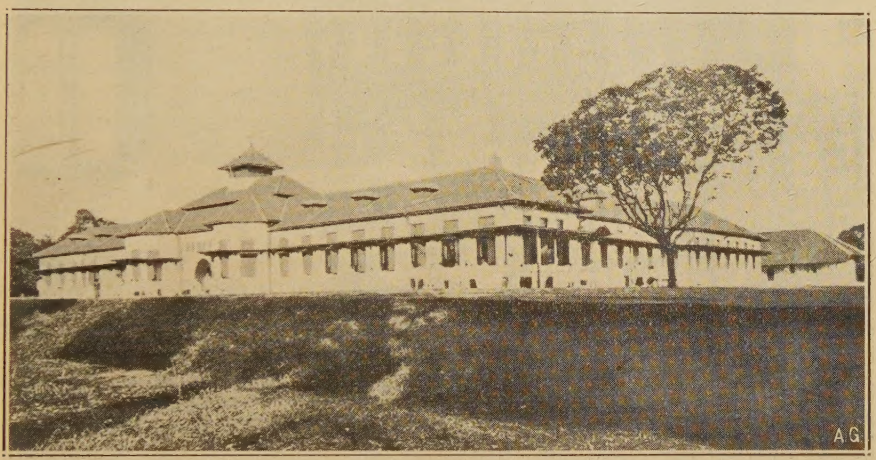
A difficulty which one should be ready to meet in the reading of Dutch literature on agriculture in the Dutch East Indies is the use of dialect words. The Dutch workers are forced to mix a number of dialect words with Dutch words in their publications. A knowledge of the dialect and the possession of a Malay-English dictionary are not complete aids in this difficulty. For these Malay or other dialect words used have been written according to Dutch spelling. For example, *u* is written *oe*; *y*, as *ij*, etc. Consequently, only through the help of the Dutch men familiar with these Dutch-Malay words can a worker understand their meaning. Moreover, verbs have been coined as derivatives of Malay nouns. For example, the Dutch-Malay verb *gepatjoeled* meaning hoed (past participle) is derived from patjoel (the native hoe). These words are not italicized, are seldom in quotations (and even when so written it is hard to get their meaning) and are almost never parenthetically defined.

Malay-English dictionaries which are sold in the ordinary bookstores lack the necessary technical qualities, hence, names of plants either are not given or are seldom scientifically correct. Native names of plants and

their corresponding scientific names may be found in K. Heyne's *Nuttige Planten van Nederlandisch Indies*, Parts I to III, preferably the second edition.

THE DEPARTMENT OF AGRICULTURE, INDUSTRY AND COMMERCE

While most of my work in Java was directly in the government experiment stations, I was interested to find out the organic position of the station and its relationship to its sister divisions. The government experiment station, generally known as the General Experiment Station, is under the Department of Agriculture, Commerce, and Industry. This Department contains several divisions for research work. These are a botanical garden, a general agricultural experiment station, a veterinary experiment station, a phytopathological laboratory, and a forestry experiment station.



(*Courtesy of Dr. Valeton, Jr.*)

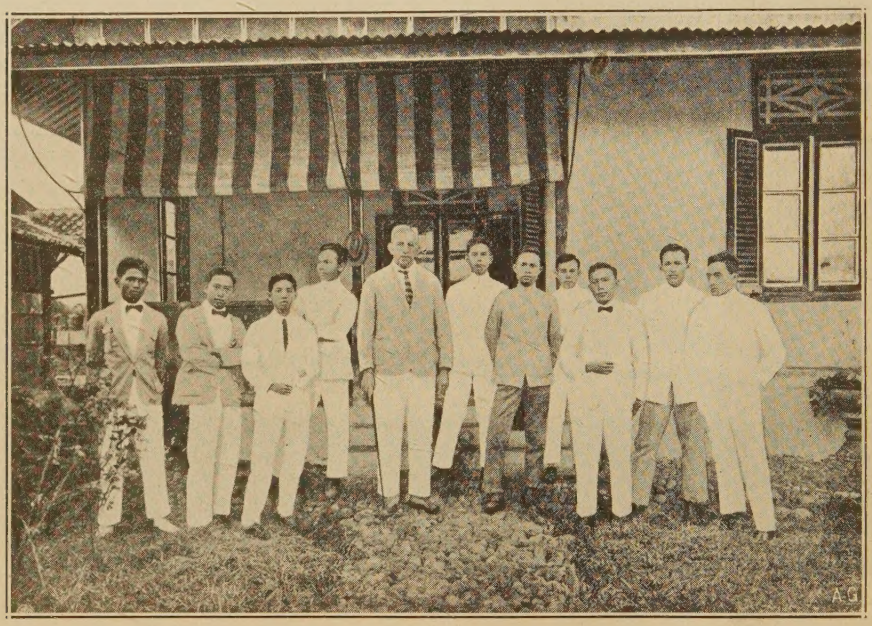
Fig. 1.—The main building of the Middle Agricultural School at Buitenzorg, Java.

Besides these divisions for research, the department includes administrative services, such as forestry service, veterinary service, schools for agriculture, a school for veterinary students, and then the Division of Commerce and the Division of Industry. The irrigation work is under the public department while the meteorological work and observatory is a part of the navy department.

The administrative officers of the department are a director, an underdirector, and a secretary. The expenses of the Department for the year 1925 totaled 19,555,237 guilders and for 1926, 21,438,642 guilders. (One guilder =0.82 peso.)

The Extension Service is under the Division of Agriculture and has for its staff, a head, two inspectors, one adjunct inspector, thirty-one agricultural advisers, seventeen middle and lower technical-officers, sixty adjunct agricultural advisers and thirty-four supervisors.

The School of Agriculture (Middlebare Landbouw School) and training of agricultural advisers and adjunct advisers. The object of the middle school for agriculture is to train young men for higher positions in agriculture, mostly for private, but partly also for government work. In academic standing, compared with similar institutions in the Philippines, it is in some respects about midway between the Muñoz Agricultural School and the College of Agriculture at Los Baños. As higher positions in agriculture are available practically only on the estates (*haciendas*), or large plantations or farms, to which most of the graduates go, it is logical to find a good deal of influence of estate owners in the school. For example, the



(*Courtesy of Dr. Valeton, Jr.*)

Fig. 2.—A group of graduates of the Middle Agricultural School at Buitenzorg shown with the Superintendent of the Moeara Seed Garden. These graduates are spending one year of actual farming on the seed farm preparatory to their entering the extension service of the Department of Agriculture in Java.

board of supervisors consists of five men besides the secretary and four of these five, including the chairman, are either estate administrators or business men. Moreover, agricultural associations and private men have raised funds for the pensioning of students in these schools.

Sons of planters are given preference. Only students who are industrious, fine in bearing, and strong in body may enjoy the pension. After graduation, those who enjoyed the pension are required to pay back by installment the money given to them during their student days. The pension varies according to demand, but in no case does it amount to more than 50 guilders (about 40 pesos) a month.

For positions of sub-agricultural advisers, the Department of Agriculture pensions a certain number of students each year. The pension is about 28 pesos a month. After graduation they are given an additional year of preparation and receive from the government about 100 pesos a month. In this last year of pre-service preparation they are given land in the Moeara Seed Station and are allowed to farm under the supervision of the superintendent of the seed farm. The training is very rigorous, as they have to do all the kinds of work on a farm. They have to rise about five o'clock in the morning to begin each day's work. After this one year of preparation the supervisor classifies them as to suitability for different positions and they are appointed accordingly. They are bound to serve the government five years as adjunct agricultural advisers.

The adjunct agricultural advisers never rise to the position of agricultural advisers (they are called *landbouwconsulenten* in Java). The agricultural advisers always come from Holland and are graduates of the agricultural institutions of that country. After arriving in Java they are required to visit and learn the working of the different divisions and sub-divisions of the Department of Agriculture, particularly of the General Experiment Station. After this they are assigned to their respective provinces.

A point worth mentioning in connection with the agricultural school at Buitenzorg is that the school yards and some of the farm practice grounds are adjacent to the important cultures of the General Experiment Station. They practice with the most important crops of Java,—rice, rubber, coffee, cacao, etc.

The absence of a college of agriculture in Java of full university grade should not be taken to mean that it is not a necessity in the agricultural work in Java. The fact is that men needed in Java for superintendents and executive work are all Dutchmen and come from a college of agriculture in Holland. The graduates of schools of agriculture in Java are never expected to take the positions that are filled by graduates of the colleges of agriculture in Holland.

In addition to the Middle Agricultural School at Buitenzorg, the Department of Agriculture directs two other vocational schools in Java. One of them is in Soekaboemi and is especially suited for training men who go out to work with tea, rubber, and quinine; the other school is in Malang and trains men for coffee and rubber work especially. Both of these schools are lower in grade than the one in Buitenzorg.

THE EXPERIMENT STATIONS

There are in Java both private and government experiment stations. The private stations look after the interests of the agriculture financed with foreign capital. The government stations, the chief one being the General Experiment Station under the directorship of Doctor Cramer, aim at the improvement of native farming.

The following figures give some idea of the yearly appropriations for some of the experiment stations:

Government		
Botanical Garden	238,593	guilders
General Experiment Station and Institute for Plant Diseases	367,129	"
Division of Agriculture	794,453	"
Private		
Tea Experiment Station (5,000 of which is government subsidy)	100,000	"
Sugar cane Experiment Station at Pasoeroean	1,000,000	"
Kina (cinchona) Experiment Station	30,390	"
Tobacco Station at Klaten	110,750	"
Experiment Station of coffee and rubber at Malang (6,000 guilders income)	128,210	"

A bird's eye view of the rôle of these different institutions may be obtained from the following statement by Doctor Cramer:

> The organization of research work in agriculture in the Netherlands Indies has followed different lines. Out of a botanical garden with a small scientific staff developed a department of agriculture, industries and commerce, which, as a government institution endeavors to stimulate these branches of human activity and to improve their results.
>
> Large plantation companies have established their own experiment stations which are absolutely independent of government control and support many of the other private stations, like those for rubber and coffee and have also local importance as they help local farmers besides doing research work, sometimes also, private interests combine and raise special funds for the solution of important problems that form a serious menace to their work. Such are the coffee borer funds.

The most significant point to remember about research work in the Netherlands Indies, as Cramer says, is that research work has "adapted itself all the time to the special needs of the moment and of the interest involved."

ORGANIZATION OF THE GENERAL EXPERIMENT STATION AT BUITENZORG

On this subject, I consulted the 1925 and 1926 annuals of the Department of Agriculture, Commerce, and Industry. Mr. Koch gave me later information on the Institute for Plant Diseases, which was not formerly under the General Experiment Station, but is now incorporated with it under the same head.

Through the direct or indirect introductions of my sponsor, I met and obtained valuable information from the following men: Mr. De Veer of the Division of Permanent Crops, Mr. Van der Meer of the Moeara Seed Garden, Mr. Groenewege of the Microbiological Division, Mr. Leefmans, Doctor Van der Goot, Doctor Schwarz, and Doctor Doyer of the Institute for Plant Diseases. My contacts also with the Librarian of the Department, with Doctor Bubberman, Head of the Veterinary Laboratories, and with Doctor Valeton, Director of the Middlebare Landbouw School, as well as with prospective *landbouwconsulenten* (similar to the higher class of the extension agents, in the Philippines), all contributed to the making of my stay in Java very instructive.

The different divisions composing this station are: Laboratory for soil research, chemical laboratory, botany laboratory, and an agricultural division. The last is subdivided into a section for annual crops and another for perennials. As stated above, recently the Institute for Plant Diseases was placed as a division under the General Experiment Station. The Institute is composed mainly of a botany laboratory, zoölogical laboratory, and the section for inspection service.

WORKING OF THE SECTIONS FOR ANNUAL AND PERENNIAL CROPS

My information on this subject is derived not only from the reprints of publications kindly furnished me by Mr. Koch and from his 1925 and 1926 Annual Reports, but from the more important sources of observations made in the fields at Tjikenmeuh and at Moeara, and from occasional explanations made by Mr Koch. The main divisions of work of the annual crops section are the improvement of rice, maize, cassava, fiber roselle, and peanut; fertilization experiments with rice and other crops; tests and use of various species of cover plants and green manures; the improvement of inland agricultural implements; and the distribution of improved seeds and improved implements, such as the Moeara plow, Moeara hand cultivator, the *katjip*, the *landak*, and the *twin landak*. I brought with me when I returned to the Philippines a model of each of these implements.

The relation of seed raising in the Moeara Seed Garden to the farm work of the prospective *adjunct-landbouwconsulenten* (whose training farms are in Moeara also) and to the system of training of these future *adjunct-landbouwconsulenten* themselves struck me as a possible model for the Philippine Government.

The work in the Section for Perennial Crops on rubber and kapok budding and the grafting of coffee as a means of multiplication of important hybrids and mother plants impressed me greatly.

After studying the method used by Mr. Koch in keeping experimental records, I came to the conclusion that it is many times better than the card or loose leaf system I have been using in the Philippines, and so I have adopted it with a little modification.

I had the privilege of taking an active part in the work of actual inbreeding of corn and selection of desirable maize strains and in the selection of rice seedlings. I also saw the rice plants being inbred, with the inbreeding bags still on, before the panicles were harvested. I also observed the methods of seed bed preparation, seed sowing, uprooting of the seedlings, and transplanting, in the rice work. The cassava plants were not in flower and hence there was no self-pollination work with this plant at that time. However, I studied the published results of cassava breeding including a tabulated system of identifying the varieties now growing in this section. As many of the cassava varieties we have in the Philippines came from this Station, this method of classification of cassava varieties will be very use-

ful to us at our College. I observed the different variety cultures of cassava of the Division. One of these cultures is of cassava seedlings grown from seeds which came from supposedly homozygous mother plants of the Randoe variety. The seedlings were far from uniform and prove the heterozygosity of the mother plants. This instance is illustrative of the value and soundness of the method now being tried by Mr. Koch in the improvement of annual crops; namely, the forced inbreeding of mother plants even of a species like rice which is supposed to be highly self-pollinating, the culture of the inbred offspring under the most favorable soil and other conditions to get the greatest variability among the plants, the selection and tests of desirable inbred strains, and the obtaining of first, second, and third (single, double, triple) crosses with such a plant as the maize. As I understood from Mr. Koch it is his plan to compare in the future the following methods of rice improvement:

1. The use of pure lines.
2. The use of mixtures of inbred pure lines.
3. The use of mixtures of inbred lines after growing them under supervision, for two generations.
4. The use of second hybrid generation seeds of two inbred lines.
5. The use of mixtures as in No. 3, but grown two generations.

In the improvement of corn, two methods will ultimately be compared; namely, the ear-remnant method of selection and the use of triple hybrids of strains produced by several generations of self-pollination. As the plan now stands, the strains to be used in the production of triple hybrids will have been inbred five times.

As to the ear-remnant method, the use of it has been in progress for five or six generations. I was fortunate in catching a planting of corn to which the ear-remnant method of improvement was being applied. The selection of the best strains, which in the cultures were represented each by fifty-five hills was based on the following points:

1. Proper time for maturity
2. Number of plants suckering
3. Number of plants producing more than one ear at one node
4. Number of plants considered abnormal. Plants showing the following characters are considered abnormal:
    a. Dwarfing
    b. Bent stalk
    c. Zigzagged stalk
    d. Ears at the tassel of the main stalk
    e. Colored plants outside the normal green
    f. Barrenness
    g. Ears with widely open tips
    h. Plants lying down
    i. Large husk blades
    j. Diseased plants
    k. Abnormal height of ear on the stalk
5. Yield

In the comparison of strains, point No. 1 is considered three times important, point No. 2, two times, point No. 3, one time, point No. 4, one time. An index of selection is obtained by finding the difference between three times point No. 1 on one side and two times point No. 2 plus one time point No. 3 plus one time point No. 4 on the other side. Strains showing a high index and at the same time giving a good yield are selected.

In regard to the obtaining of the inbred strains to be used in the production of triple hybrids, I obtained the information that the work was started with about 1,000 ears. From this number about 300 were selected with which to start the inbreeding. After four generations of inbreeding, there have been ultimately saved or have survived ten strains or numbers. To save some of these the plants had to be manured and taken exceptionally good care of otherwise. I was lucky in being able to see these strains in the field and to see the operations of inbreeding, which is now in the fifth generation. The ten numbers which have been saved will be used in the production of forty-five combinations or forty-five triple hybrids, the yields of which will be compared. The selection of strains each generation can not be based on the yield as the plants are treated and hence the yield is not normal. Determining the yield by the ear-remnant method is not practical as not enough seeds are obtained to allow the saving of the "remnant" material. But the selection is based on characters which are supposed to give a reliable index to yield. These characters are:

1. Earliness and uniformity of flowering
2. Uniformity of height of plants
3. Tendency not to produce suckers
4. Tendency not to produce more than one ear at one node
5. Tendency not to bend or lie down
6. Resistance to pests and diseases
7. Freedom from other abnormalities

The process of self-pollination is done at about noon, the cultures being visited every day for such plants as are ready to be treated.

In the work of corn breeding, an attempt is being made to determine the best method of self-pollination. The use of bags made of drill cloth for covering the female organ is being compared with the use of paraffined bags with protection from too much heat from the sun. Two kinds of protective material are being tested, the ordinary woven-bamboo and the asphalt paper, the kind used in Hawaii for mulching pineapple and sugar cane fields.

An important phase of the work in Mr. Koch's section is the selection of rice strains resistant to the bending effects of the weight of their fruits, of wind, and of other factors. A machine for determining the bending resistance of individual plants just as these stand in the field has been devised by Mr. Koch for use in this determination. In addition to the use of this physical method of determining bending strength, Mr. Koch's as-

sistant, Mr. Van de Meulen, is making an attempt to determine if strains may be selected for this character on the basis of the anatomical condition of the rice stem. Both the physical and anatomical methods are relatively new to me as far as rice is concerned, and deserve serious study.

In the Section for Perennial Crops the most important subjects I studied were the improvement of rubber, including the propagation by budding; the improvement of coffee, a good deal of which work is done in the Government Coffee Estate at Bangelan; and the improvement of the coconut plant, kapok, and oil palm. Following are some of the unelaborated notes I made while visiting the Bangelan Coffee Estate:

My informant in Bangelan was the Superintendent of the Estate, Mr. Doornberg, to whom I am deeply indebted. The main lines of work in Bangelan are:

1. Crossing of varieties. In the production of hybrids the method used is to plant the parent varieties side by side and allow insects to do the cross pollination. The variety Congensis is said to cross easily. Small bean flowers generally cross easier than large bean flowers, because the latter self-pollinate before opening.
2. Sowing the seeds in the nursery
3. Selection of hybrid seedlings in the nursery
4. Planting out the selected seedlings
5. Selection of superior trees. The points on which selection is based are yield, resistance to diseases and pests, size of bean, and length of bean stem. If the stem of the bean is short, the beans become crowded and some of them will be small. Therefore, short stem beans are avoided.

Usually three years and nine months waiting is necessary before selection is accomplished. To hasten work, selection is done when the seedlings are eight months old. The selected seedlings are grafted on old stocks, which are always available. At two years of age the grafted plants begin to produce, and so a saving of one year and nine months is effected.

6. Preparation of sixteen grafts from each selected tree, and planting these grafts in the Museum Garden.

In grafting, the stock used is about the thickness of a finger. If stumps are grafted, four sprouts are grafted at the same time, then ultimately thinned to one. The variety commonly used for stock is Robusta 129.01 which is supposed to be a hybrid between Robusta and Quillou. Quillou itself is a good stock.

In the Museum Garden the plants are distanced 10×10 feet if Robusta and Kawisarie hybrids; 12×12 feet if Excelsa and Liberica; and 8×9 feet or 8×8 feet or 9×9 feet if Arabica or Congensis. The depth of the hole is $1\frac{1}{2}\times1\frac{1}{2}$ feet in Bangelan where the soil is deep. If underlaid by hard pan, the hole goes through this.

7. If a clon in the Museum Garden is selected, 49 grafts are made nd planted in another garden. If this clon is exceptionally promising, in

addition to the 49 grafts, a hectare of grafts and another of seedlings are planted to it in the hectare gardens. In getting seeds from the Museum Garden, only trees in the middle of the culture are used to insure a high state of purity.

8. The hectare gardens are kept under observation for from two to three years, after which time, one is able to tell the true value of a clon. If found desirable, it is used for the production of seed for distribution outside. At the time of my visit I was informed that there were already clons occupying three to four hectares each.

Fig. 3.—An introduced budded plant from mother tree No. 88, supposedly the best Hevea mother tree known in Java.

The value of a clon is finally known after nine years; in less time if it is extraordinarily promising.

The other phases of Bangelan work of interest to coffee planters are the use of cover crops and shade trees, pruning of coffee trees, and the control of coffee borers. An excellent system of recording observations and performance records of trees is used.

SOME OF THE PRIVATE STATIONS

The private stations I visited are the Central Rubber Experiment Station at Buitenzorg, the Tobacco Experiment Station at Klaten, the Sugar Cane Station at Pasoeroean, the Cinchona Experiment Station at Tjinjiroean, Pengalengan, the Coffee and Rubber Experiment Station in Malang, and the Tea Experiment Station at Buitenzorg.

In the Rubber Experiment Station my informant was Doctor Bobilioff who is in charge of the rubber breeding work. I learned from him the method in use at the station in the improvement of rubber. This method includes the keeping of performance record of yield and the number of latex vessels of individual trees, the selection of the superior ones and the propagation into clons of these selected trees. As a result of this work there are now being tested in Sumatra eleven clons and in the Test Garden at Buitenzorg, thirty clons. Both the experiment station and the commercial estates have their test gardens.

In the Experiment Station Test Garden each clon is represented by 20 to 23 trees; in the private estates, by very many more.

It is estimated that it is necessary to tap a clon for seven years, at least, before its commercial value can be conclusively determined. Because heavy tapping tends to make a tree very susceptible to brown bast disease, the frequency of tapping has been changed. Formerly a tree was tapped daily around two-quarters; later on one-third or one-half circumference, half daily, and now, the method has been changed to alternate days.

The determination of average yield per tree per day is done once a month. This is sufficient, although some estates do this once a week.

Like the Rubber Experiment Station, the Tobacco Experiment Station at Klaten is a privately supported institution; it looks after the interest of the tobacco estates in Java. In Sumatra the corresponding station is the Tobacco Experiment Station at Delhi. There is no organic connection between the two stations. The station at Klaten is supported by 19 estates which paid in 1926, 0.64 cents Java currency (equivalent to about 50 centavos Philippine currency), per pound of tobacco produced by them. In the year 1927, it is expected that the estates supporting the station will grow about 9090 bouws (1 bouw = 0.71 hectare) of tobacco and will have to contribute 110,750 guilders for the support of the station. The breeding garden of the station occupies 10 bouws, five of which are used every year. Some of the tobacco farms under the estates are irrigated and some are not. In irrigated places rice is grown in rotation.

The important lines of work of the station are: The separation and germination test of seeds for different member estates. In seed separation a winnowing machine is used consisting mainly of a motor which runs a fan. The rate of revolution of the motor and the amount of velocity of wind

from the fan may be controlled, and hence different grades of seeds may be separated. The test of seed germination is performed in the laboratory.

The main work in the improvement of tobacco consists in crossing different varieties, the most important of which are EK, Canary, and Doorschieter. There are two strains of Canary, the normal and the dwarf.

The study of tobacco pests and diseases is a very important phase of the Klaten work. A book embodying the results of this study and covering a long period of time was published in 1921.[2]

I am indebted to Mr. Beet, Acting Director of the Station for information on the Station work and for taking me around the stations during my visit in Klaten.

The Government Cinchona Experiment Station. This station was established on May 31, 1911 and located at the government cinchona plantations in Tjinjiroean, Pengalengan, near Bandoeng. The personnel consists of a director, a botanist, a chief analyst, an analyst and an agricultural assistant. The work of the station consists in:

1. Making commercial and agricultural analyses of cinchona bark
2. Sending out advice regarding cinchona culture
3. Doing chemical, botanical, and agricultural research work to improve cinchona culture

The Government cinchona plantations are found in Tjinjiroean, Tjibeureum, Rioeng-goenoeng, Kawali-Tjiwidei, Nagrak, Rantja-Blang, Tjibitoeng, Telaga Patengan and Lembang. All were established about 1860 by Junghuhn. Nagrak and Lembang are on the slopes of the Tanghoeban-Prachoe, the other seven are on the Malabar mountain, Pengalengan plateau, and the Kendeng and Pasoeak mountains. In 1877, another plantation, named Tirtasari, was established. Many of these plantations were abandoned. At present the plantations are Tjinjiroean and Tirtasari, Tjibejureum, Poentjak Gedeh, Tjibitoeng and Rioeng-goenoeng. In 1925, the harvest was 669,300 kgm. dry bark, 655,265 kgm. of which was "fabric" (factory) bark and the rest, 13,035 kgm. was pharmaceutical bark.

Some idea of the rainfall in these plantations may be gained from the following figures which are the average for 10 years preceding 1925:

	mm
Tjibeureum	1176
Tjibitoeng	1136
Tjinjiroean	2775
Rioeng-goenoeng	3320

In the nurseries, there were, at end of 1925, 1,314,000 plants as follows:

433,000 Ledgeriana seedlings
433,000 Succirubra seedlings
448,000 Ledger buds on succirubras

[2] Jensen, Hj. 1921. Ziekten van de Tabak in de Vorstenlanden. Mededeeling No. XL, Proefstation voor Vorstenlandsche Tabak.

The total area at end of 1925 was 877,937 hectares, as follows:

	ha.
Ledgeriana	832,560
Hybrids	12,364
Succirubra	33,013

Private cinchona plantations. The oldest of these plantations were started in 1864. At present there are 108, giving a harvest of 20,000 to 61,000 kgm. bark. The total for 1925 was 559,895 kgm.

The so-called Government Experiment Station of Cinchona has ceased to be such, although the station (at Tjinjiroean) is still located in the Government Estate. The station is now privately supported by different plantations and the government plantations are on the same footing as the private.

(*Courtesy of Dr. Valeton, Jr.*)

Fig. 4.—At the left is shown one of the graduates of the Middle Agricultural School using the "Moeara" cultivator in the seed farm.

The Sugar Experiment Station at Pasoeroean. This station is said to be the largest of its kind in the world. It is supported entirely by private companies and concentrates on only the one crop, sugar cane. "It has not only control divisions for studying the agricultural problems of cane production, for the improvement of the chemical and mechanical processes involved in the industry, but also a set of agents scattered over the principal cane growing districts, linking up the local planter with the central stations."

The Station spends yearly for breeding and other activities about one million guilders (about 900,000 pesos). While the office and much of the

work of the cane breeder are in Pasoeroean, the greater part of the hybridization work is done at Blambangan. The man in charge of the breeding operations is Doctor Posthumus. Doctor Jeswiet and Doctor Bannier are no longer in Java.

At present the Experiment Station at Pasoeroean believes that 2878 POJ is the best variety it has produced; it is expected, after a few years, to supplant the other varieties which have been popular, such as DI52 and EK28. It is believed that it would be quite difficult to produce a variety better than 2878 POJ. This variety needs no mountain garden for the production of desirable and healthy points. However, the breeding work in Pasoeroean and in its breeding garden at Blambangan is being prosecuted with undiminished energy. 2878 POJ was 1 seed in 1921, 1 plant in 1922, occupied 0.01 bouw in 1923, 50 bouws in 1924, 1752 bouws in 1925, and 30,591 bouws in 1926.

There are two things which should be of interest to cane planters in the Philippines in connection with the production of seedling varieties in Java. These are the payment of a royalty to producers of good seedling varieties and the Jeswiet method of identifying varieties. The rules governing the payment of the royalty are published in the Yearbook of the Sugar Syndicate. The offer of this royalty is intended to stimulate the breeding of improved varieties. Whether or not a variety is new is decided officially by the Experiment Station and in this decision, the method devised by Doctor Jeswiet for identifying varieties plays a very important rôle. The Jeswiet method is rather elaborate, and based on the observation of about thirty-two hair groups on the bud and twenty-one on the leaf. That this method is found to be effective in clarifying nomenclatic confusion is shown by the record at Pasoeroean. It has been found, for example, that ten or more variety names used in Java or elsewhere may really refer to one single variety. By applying the method, names have been reduced to two-fifths the original number. In the future it is probable that cytological examination will play a more important rôle than it does now in determining the identity of a sugar cane and in tracing its genetic origin. Doctor Bremer in Pasoeroean who kindly explained to me his work on the chromosome of *Saccharum* species has been working along this line for a number of years and has obtained wonderful results.

One thing which impressed me much in Pasoeroean is that the greater part of the breeding work is not done there but in Blambangan which is about three hundred meters higher in elevation than Pasoeroean. The reason for having the breeding garden in Blambangan is that many parent varieties do not flower in Pasoeroean at the same time as those with which they should be crossed. In Blambangan they flower at the same time and hence crossing is possible. For a full account of the cane breeding work in Java for the period 1893–1925 reference may be made to Doctor Bannier's paper published in the *Archief voor de Suikerindustrie in Nederlandsch-Indie*, No. 19, 1926.

Along entomological lines, I was given the privilege of a conference with an entomologist of the station, Dr. E. H. Hazelhoff, who explained to me in brief the work of the station in the importation of natural enemies of the sugar cane borers and white louse and the propagation of these enemies, both imported and native, on the estates as a means of lowering the cost of controlling cane pests. I was informed that an estate spends in general six to ten thousand guilders a year in combating the white louse by means of soap emulsion and tobacco extract. One of the louse parasites being propagated is *Encarsia flavoscutellum* Zehntner.

(*Courtesy of Dr. Valeton, Jr.*)

Fig. 5.—A class in the Middle Agricultural School learning how to tap Hevea rubber trees.

Coffee and Rubber Experiment Station at Malang. At this station I met Doctor Ultee, the director; Mr. Rishambers, in charge of coffee; and Mr. W. Bally, in charge of rubber investigations. This station has a seed garden at Soemberasin which I did not have an opportunity to see. The station looks after the interests of estate coffee plantations, not of the plantations of the natives. Station support is obtained from a tax of one guilder per hectare of estate members and about 20 cents per picul of coffee produced. This last tax varies each year.

Vegetative propagation is a very important phase of the work. The variety used as stock is usually Excelsa.

In selection, the following characteristics are preferred: large size of bean, big production, resistance to coffee rust, good development and strong trees.

Cover crops used: The cover crops used in the Java coffee plantations are usually *Indigofera hendecaphylla*, used especially to protect sloping lands from erosion, *Crotalaria anagyroides*, *Carotalaria usaramoensis*, *Vigna oligosperma*, and *Centrosema pubescens*. For shade trees: *Lucaena glauca*, *Albizzia stipullata*, *A. Moluccana*, *A. sinensis* and a few others. Formerly, Hevea trees were also used but at present it is not a common practice to use this species as it is considered dangerous to plant coffee and rubber together.

As to rubber work, I was informed that one of the selected clons now yields per tree 40 grams a day at 9 years of age. This yield represents the average of 100 trees. Very few clons come out good.

The Tea Experiment Station: I met the director of the station, Dr. Ch. J. Bernard and also Doctor Stewart, the tea expert and breeder who took great pains in explaining to me the work he was doing in tea improvement. Mr. Keuchenius who is in charge of the vegetative propagation garden and the cover crop and shade plant cultures of the station took me to see these cultures and explained in detail the objects of his many experiments.

The important lines of work of the station are:

1. Selection of best yielding strains of tea
2. Propagation both by seed and by grafting of the selected plants
3. Test of different species of plants for cover crop and shading purposes

Doctor Stewart was kind enough to take me to the selection gardens and to the garden containing grafts of the selected plants. These gardens are in the Pondok Gedeh Estate, and are located many kilometers from Buitenzorg. I was informed that the station has cultures in five other estates in Java. A visit to a tea factory supplemented my tea studies.

FRUIT STATION IN PASOEROEAN

This station was in the care of Mr. E. de Vries, horticulturist. The important cultures are mango, banana, pumelo, and cover crops. The best varieties of mango, Aroemanis, Goleh and Madoe are represented in the station's collections. There is a variety which is probably a natural cross between Aroemanis and Goleh and bears a name which means *ne plus ultra*.

One important work is mango budding. Ninety-four per cent success has been reported. No wax is used with the binding tape but the plants are partly shaded. In the culture of fruit plants use is made of cover crops such as *Mimosa invisa* and *Calopogonium muconoides*.

An interesting banana that I found is called Pisang Sewoe (*Musa chilliocarpa*). The bunch is several meters long, reaches the ground, some-

times necessitating the digging of a hole in the ground to accommodate the elongation. The first three or four hands of flowers are male and the rest, female.

PLANT INTRODUCTION

As a result of my fellowship stay abroad, I was able to introduce into our College planting materials of about one hundred species of plants, the most important of which are seeds of selected plants of rice, peanut, roselle and *Hibiscus cannabinus*, budded plants and buds of the best clons of Hevea rubber in Java, two budded plants of the coffee hybrid (Kawisari B) in Java, seeds of the two best species from selected plants of *Cinchona* (quinine), the sweetest varieties of Java pineapple, two species of *Artocarpus*, new or not common in the Philippines, four living plants of the Surinam kapok, found to be excellent stock for budding the ordinary kapok, the best variety of *Lansium domesticum* known, the Duku, two varieties of banana related to the banana of commerce for use in our banana breeding work in this College, seeds of the best species of cover and green manure crops of Java and many others.

I brought also a model of each of the improved agricultural implements produced by Mr. Koch of the General Experiment Station. These implements are the Moeara plow, Moeara cultivator, *katjip*, *landak* and *landak kembar*. The last three are for weeding lowland rice fields. The *Moeara wiedtoestel* is a cultivator for dry land. All of these implements promise to be valuable in our agricultural promotion work in the Philippines.

A complete list of the plants introduced follows: *Achimenes* sp.; *Achras sapota* L.; *Amaranthus* sp.; *Ananas comosus* Merr.; *Arachis hypogaea* L.; *Aristolochia* sp.; *Artocarpus integra* Merr.; *Artocarpus rigida* Bl.; *Artocarpus champeden* Srpeng.; *Asparagus* sp.; *Aster* sp.; *Baccaurea racemosa* Muell-Arg.; *Cassia Fistula* L.; *Caladium bicolor* Vent.; *Cassia grandis; Cassia multifuga; Cassia nodosa* Ham.; *Calopogonium muconoides* Desv.; *Carica papaya; Ceiba pentandra* Gaertn. Var. Caribaea; *Celosia Cristata* L.; *Coleus tuberosus* Benth.; *Cosmos* sp.; *Coreopsis* sp.; *Cinchona Ledgeriana* Moens.; *Cinchona succirubra* Par.; *Crotalaria Juncea* L.; *Coffea arabica* x *C. liberica* (Kawisarie B.); *Cyrtostachys lakka* Becc.; *Cyrtostachys rendah* Bl.; *Cleome* sp.; *Clematis hirsuta; Dialium indum; Diospyros kaki* L.; *Flacourtia inermis* Roxb.; *Gerbera jamesonii* Bol.; *Gladiolus* sp.; *Glycine max* Merr.; *Helianthus* sp.; *Hevea brazillensis* Muell.-Arg.; *Hibiscus Sabdariffa* L.; *Hibiscus cannabinus* L.; *Hydrangea hortense; Hippeastrum* sp.; *Impatiens sultani* Hook.; *Indigofera hendecaphylla* Jacq.; *Impomoea batatas* Poir.; *Impomoea* sp.; *Jacaranda ovalifolia* R. Br.; *Jacobinia vellutina; Lansium domesticum* Jack.; *Latania commersonii* Grnel.; *Licuala grandis; Licuala amplifrons* Mig.; *Manihot utilissima* Pohl.; *Manilkara kauki* Dubard; *Mirabilis jalapa* L.; *Musa sapientum* L. Houth.; *Myristica fragrans; Nephelium lappaceum* L.; *Nephelium mutabile* Bl.; *Oryza sativa* L.; *Phajus tankervilliae* Bl.; *Pelto-*

phorum ferrugineum Benth.; *Poinciana regia* Bj.; *Parkia speciosa* Hassk.; *Phaseolus radiatus.; Phlox drummondi* Hook.; *Plumiera acutifolia* Poir.; *Salvia* sp.; *Solanum* sp.; *Spathoglottis plicata* Bl.; *Spathodea* sp.; *Tagetes* sp.; *Tephrosia candida* DC.; *Tephrosia noctiflora* Bojer.; *Tephrosia vogelii* Hook.; *Theobroma cacao* L.; *Thrinax argentea* Lodd.; *Torenia* sp.; *Vigna Hosei* Backer. (*V. Oligosperma*); *Voandzeia subterranea* Thouars; *Zea mays* L.; and *Zinnia elegans* L.

The plant materials in the preceding list were introduced in three ways:

(1) By mail. Every month during the period between January 9, 1926, and July 18, 1927, I sent to my assistants in this College several shipments of seeds and other propagating materials. When I returned August 23, 1927, I found most of the plants from these seeds growing.

(2) When I returned, I brought with me three Wardian cases and one box full of plants. One of the Wardian cases contained plants I bought and collected from private sources, one contained plants given to me by the Botanical Garden at Buitenzorg, and the third contained four budded stumps of Hevea, four seedlings of Surinam kapok and two budded plants of the coffee hybrid Kawisarie B, all from the Economic Garden of the General Experiment Station. The open box contained an assortment of plants from the Botanical Garden at Kuala Lampur. With my experience in bringing these cases to the College I can now understand why it is not always easy to introduce plants in Wardian cases without some one to take care of them on the way. In the first place one species may be adapted to the case while another is not. Had I not been with my cases, probably fifty per cent of my plants would have perished en route.

(3) Besides the plants in the cases and box, I brought with me many samples of seeds, mainly from the section of Annual Crops of the General Experiment Station, from the Botanical Garden at Kuala Lumpur, and from the Experiment Station at Serdang, Federated Malay States.

THE SEASONAL DISTRIBUTION OF EGG PRODUCTION: THE NORMAL EGG PRODUCTION CURVE[1]

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WITH TWO CHARTS

It is accepted that the tropical countries are the original homes of the progenitors of the present day breeds of domestic fowls. As human civilization has progressed so has the domestication of poultry. Peoples have moved from place to place, and often to regions where the conditions are very different from those found in the tropics. In these migrations the domestic hen has been taken along as an essential part of the household. By instinct, the hen adapted herself to her new abodes so that her kind could be perpetuated. This power of fowls to respond readily to the environment is an attribute which only domestic animals possess.

In temperate countries, like the United States and Canada, the number of the hen's working hours is considerably less during the winter months than during the other months of the year. Because the egg production is lowest during these cold, short winter days, it is usual to attribute this phenomenon in the distribution of egg production to the marked changes in weather and other environmental conditions. In tropical countries, the difference in the length of day and night during the different seasons of the year is practically nil. Similarly, the variations in the temperature during the year are small. Basing judgment on the reasoning advanced in the usual explanation of the peculiar seasonal distribution of egg production in the temperate countries, should a definite and fairly uniform distribution of eggs be expected in tropical countries such as the Philippine Islands, Java, Borneo, Siam, Sumatra, and India?

Information obtained from various reliable sources from different parts of the Philippine Islands leads to the conclusion that egg production varies with the different seasons, there being more eggs produced during the first half than during the latter half of the year. Observations in the local market of Los Baños and in the markets of the neighboring towns seem, in a general way, to bear this out, as there is a scarcity of hens' eggs in the markets from August and a decided scarcity during the months of November and December. Such a scarcity is not experienced during the first six or seven months of the year. It appears, therefore, that there is a certain definite variation in the number of eggs produced in the different parts of

[1] Experiment Station contribution No. 528. Received for publication January 11, 1928.

the year. To determine how much this variation is and thereby establish a distribution curve as may be expected under natural conditions was the object of this study. It is hoped that the data here reported will furnish an answer to the frequent question as to the number of eggs that one may expect from a flock of hens during any given month of the year.

The study was conducted with the use of the poultry flocks of the College of Agriculture. It was started in 1922, and a number of preliminary reports have been made. The first of these progress reports (Catambay, 1924) presented the data obtained during the first year of this study, 1922-1923, for Cantonese, Native, Rhode Island Red, Barred Plymouth Rock and White Leghorn breeds of chickens. The second report (Fronda, 1924) gave the data for only the Cantonese breed, and the third report (Fronda, 1927) presented the data obtained during the first four years of the study for only the Cantonese and Native breeds of chickens. The fifth year of the study is now completed and a full report can now be made with perhaps sufficient grounds for more definite conclusions.

The egg records of the flocks of the College from September, 1922 to August, 1927 were compiled and used in this study. The chickens were classified according to breed, and separate tables were prepared for each breed. All of the breeds used in this study were kept in separate pens, and received practically the same treatment. None of the birds were allowed to set, and broodiness was broken by confining the broody hen for three or four days in a compartment provided with a concrete floor. Some minor changes were made in the course of the study, but whatever their nature they were made common in all of the pens under consideration. The chickens received what is considered under local conditions as perfectly normal egg laying rations throughout the five years this study was carried on. All the breeds had from fifteen to eighteen birds in each pen, with the exception of the Cantonese breed, in which there were at least twenty individuals in the pen during the first three years of this study, and about forty each year during the last two. The Rhode Island Red breed was not included in the study during the last year, as the number fell below ten, and during the last part of the year only a few hens were left.

For comparison, data obtained both from the United States and Australia were used. These data are only for one year; they are, however, considered as representative of conditions actually existing in those countries. For the purposes intended in the present report, these one year records are considered sufficient.

RESULTS AND DISCUSSION

The results obtained in this study are given in tables 1 to 5. The average percentages of egg production are graphically presented in chart 1. The average figures given in the tables were reduced to the "number of egg" basis and the results are given in table 6. This was done in order that

the figures may be readily applied by those who may care to use them as guides in poultry raising operations. A comparison of the data for the Cantonese with those obtained in the United States and Australia are given in table 7 and presented graphically in chart 2. It may be mentioned in passing that the Cantonese fowls were chosen and compared with the most common dual purpose breeds in those two countries for the reason that the Cantonese is the most common breed in this locality.

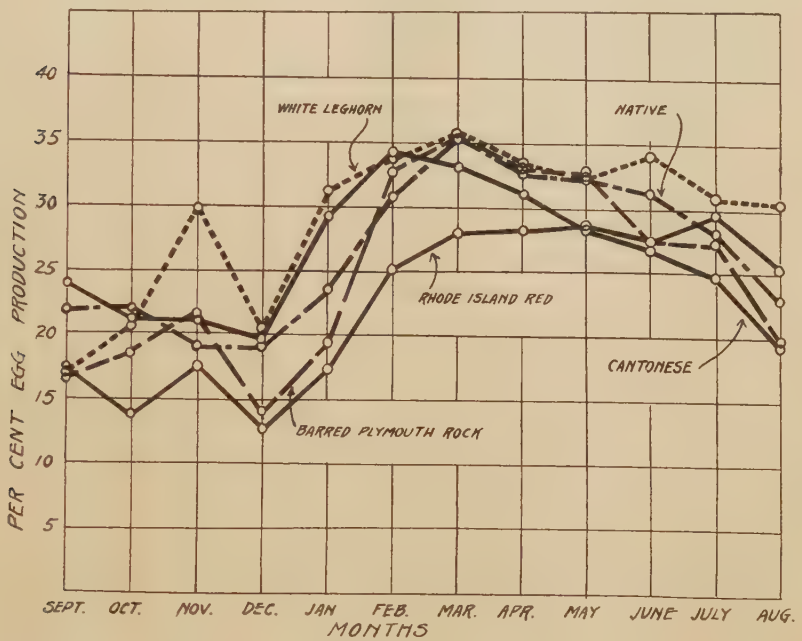

Chart 1.—Showing the distribution of egg production of Cantonese, Native, White Leghorn, Barred Plymouth Rock and Rhode Island Red breeds. Average for five years, 1922 to 1927.

It may also be seen in the tables that the "laying year" does not coincide with the calendar year, that the laying year begins with September and ends with August, instead of beginning with January and ending with December. The reason for this is that most of the hatching of eggs done in this College is made from December to March, inclusive, as these months have been found to be the best for this purpose (Resananda, 1925); and a majority of pullets hatched during these months will begin laying in September, though some of them may start as early or even earlier than the middle of August. Thus, in order that a full year's egg record of a pullet may be obtained, the record must be started right at the beginning of the laying period. For this reason, September 1 of every year has been arbitrarily chosen as the beginning of the laying year.

The "percentage egg production" is obtained by dividing the actual number of eggs laid by the flock in one month by the "total possible number of eggs" for that month, and multiplying the quotient by 100. The total possible number of eggs from a flock is obtained by multiplying the number of hens in the flock by the number of days of the month during which time they were in the pen. Thus, if a flock of 100 hens laid 25 eggs in one day, this means that 25 out of 100 hens laid during the day, thus the egg production of the flock is expressed as 25 per cent. Similarly, if a flock of 20 hens had a 25 per cent production in September, this means that 150 eggs were produced by that flock during the month.

From these data, it may be seen that there is a very significant period in which egg production is really below the average and that practically this period falls during the same period of the year in all of the breeds studied. It may be safely concluded, therefore, that there is a definite type of egg production curve in this country. Starting at almost the same level in the month of September the curve slowly declines until the minimum production is reached some time in either November or December. Then by the month of January it begins to rise, this higher level being maintained until about May or June whence egg production begins gradually to decline again. By comparing the figures in tables 1 to 5, such a tendency is shown by all of the breeds represented in this study. The figures given in table 6 show this peculiar distribution very markedly. It is of interest to note in this connection that similar results as regards egg production have been observed among Native hens by Mariano (1919) and by Fronda (1919) working independently in different years.

Attention may be called also to the slight deviation from this general tendency in the figures in tables 3, 4, and 5. In these tables, it may be seen that instead of following the general tendency to gradually drop at the start, the curves slightly rise to a point reached in November then the general drop is followed. This is due to the fact that these pens are made up of about a half and half mixture of hens and pullets. The pullets are just beginning their laying year. They lay for a short period after they reach the period of maturity, and thus the tendency is for a slight increase in egg production of the pen during these early periods of the laying year. The Cantonese and Native breeds on the other hand were always composed of hens, and therefore more homogeneous than either of the pens representing tables 3, 4, and 5. Thus, their egg production curves are very uniform from the beginning to the end of the year. The curves of the White Leghorn, Barred Plymouth Rock, and Rhode Island Red followed the general drop in December and from then on, the egg production curves of all breeds represented in this study are essentially the same.

That this kind of egg production curve is very similar to those of the United States and Australia, although they do not exactly coincide as to the time of the year is shown by the data given in table 7, and presented graph-

ically in chart 2. The time of the year at which the low and the high production occur in these different places is perhaps explainable by the differences in the weather conditions and other environmental factors. It is very apparent that there is a definite period of productivity and a definite period of rest, and that these periods occur at definite parts of the year depending upon the surrounding conditions in the locality. A more detailed discussion of the influences of seasonal changes on egg production curves will be taken up in a later paper. Let it be sufficient to state for the present that the periods of reproductive activity and of rest in the United States are in exactly opposite parts of the year from those periods in Australia for the reason that when the weather is nice and warm in the United States, and therefore favorable for egg production, it is cold and dreary in Australia and *vice versa*. Thus when the egg production curve rises in the United States, the tendency is to drop in Australia and when the chickens are most actively laying in Australia, the chickens are going through their period of rest in the United States. Because both the United States and the Philippines are in the Northern Hemisphere, the different seasons of the year occur during practically the same parts of the year, and hence the egg production curves of the chickens in these two countries follow the same trend. That is, when egg production increases in the United States, the tendency is also towards an increase in this country. The variation of egg production is not so marked in this country as it is in the United States probably because the weather conditions in the Islands are much more uniform than in the United States. The relationships of the egg production curves in this country and those of the United States and Australia are very plainly shown in chart 2.

The most striking egg production curves among poultry in United States has usually been attributed to climatic influences (Pearl and Surface, 1909). A considerable amount of work has been done and is still being done to overcome these forces of nature which offer a great obstacle to successful poultry farming in the temperate countries. The use of artificial light to increase the number of the hen's working hours during the winter months thus increasing the winter egg production has revolutionized the poultry industry in the United States and Canada. In its use, profitable results in increased egg production are obtained within a certain limit; the poultry farmer realizes an increase in his income resulting from an increased egg production during a period when ordinarily and normally there is low production.

When it begins to warm up in the spring, the hens lay better, and for this reason, it has always been assumed that the warmth of the spring causes this increased egg production during the spring months. But it has been pointed out by Pearl (1909) that "there is strong evidence to show that the shape of the egg production curve is based upon deep seated biological factors rather than directly on these climatic changes." That the small

climatic variations in the Philippines may have some influence on the egg production curve has been pointed out by Catambay (1924), but it is very plain that this egg production curve is built upon the same plan as those found in the temperate countries. As the progenitor of the present day domestic breeds of fowls is the Red Jungle Fowl common in the forests of this and other neighboring tropical countries, there is no reason for entertaining any doubt as to the similarity of the general plan of the egg production curves of fowls here and in other countries. The variations that are noted at present are merely modifications which are brought about by the peculiarities in the environmental conditions in their respective countries. How much influence these environmental factors exert upon the characteristic egg production curve of fowls in this country is a matter to be taken up in a later paper.

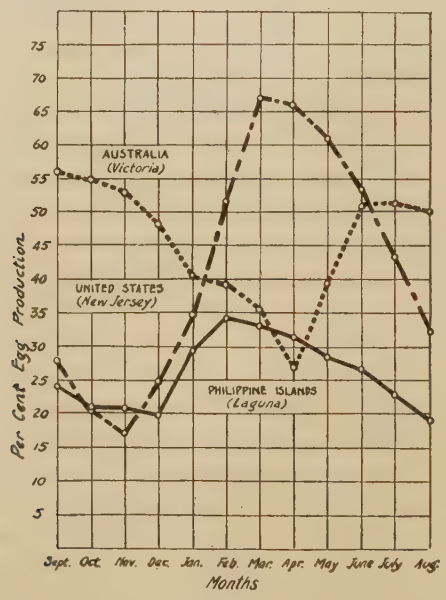

Chart 2.—Showing the curves of egg production in Australia (Victoria), in the United States (New Jersey), and in the Philippine Islands (Laguna).

There is sufficient reason to believe, therefore, that the curves of egg production reported in the present paper more closely follow the normal curve of the primitive races of poultry than those observed in temperate countries. Under the wild state, the chickens, by instinct, realize that they have to reproduce in order to perpetuate their kind, and that they have to do this when the weather conditions and the supply of food are most favorable; that is, during the period when the rearing of their most delicate young

is highly favored. After rearing their young, the adult individuals need some rest, and while their reproductive function is resting, they change their coat of feathers which had become old, ragged and dirty, preparatory for the next breeding season. Thus it is very plain that prior to the breeding season, chickens renew their vigor in much the same way that mammals exhibit unusual vigor and health just before the approach of the sexual season, as shown by the fighting and excitement common among wild animals during this period. By the end of this season, with these animals, fighting and excitement cease, the males become friendly, and in the case of stags, the antlers are shed shortly afterwards (Marshall, 1922).

Under the influence of domestication, such a course of affairs may not be found true to the very letter, because the domesticated birds are made to produce enough eggs to perpetuate their kind, in addition to the number necessary to pay for their keep and for the use of their keepers. For this reason, instead of completely resting during their period of rest, our domestic birds manage to produce during the regular breeding season. Thus it was observed by Pearl (1911) that in Maine "the laying year may be divided into four natural periods or cycles with reference to egg production." The first of these, the winter period which is roughly from November 1 to March 1, he claimed is essentially a non-essential process as the chickens are forced or stimulated in producing eggs during this period. The spring period, March 1 to June 1, which is the second of these periods, he claimed is the natural laying period of the domestic fowl in its reproductive cycle. From June 1 to September 1 forms the third period, and the fourth falls from September 1 to October 31. These last two periods are not sharply separated from one another.

Under local conditions it appears that there is but one reproductive and one rest period during the year. These correspond roughly to the two distinct dry and wet seasons of the year. The annual molt which forms the characteristic feature of the end of Pearl's fourth period marks the beginning of the breeding season, and the end of the period of rest. This molt has been observed in the Philippines to take place about July and continue to the early part of December, and this coincides in general with the gradual drop of egg production which begins about July or a little bit earlier. By January, all of the birds have completed their molt so that egg production increases until the peak is reached about the months of February, March, and April. This is maintained throughout the dry months of the first half of the year. If the fowls have had a chance to start in their reproductive processes earlier in the season, under natural conditions, a second or even a third clutch of eggs may be laid during this favorable period of the year. The earlier part of the latter half of the year is marked by rains and not infrequently storms, during the latter part of this period, the days are mild, but still there may be considerable rain at times.

The number of eggs laid by the birds during each of these periods,—the reproductive and the rest periods, is a different question altogether. This is dependent upon the age and individuality of the birds, the amount of care given them in feeding, housing, and management, and other things. A discussion of these factors is outside the scope of the present paper.

SUMMARY AND CONCLUSIONS

1. The monthly percentages of egg production of Cantonese, Native, White Leghorn, and Barred Plymouth Rock breeds of chickens for five years, 1922 to 1927, and of Rhode Island Red for four years, 1922 to 1926, are presented in this paper.

2. A comparison of the egg production curve of the Cantonese breed is made with that of the Black Orpington in Australia and of the Barred Plymouth Rock in the United States.

3. The data presented show conclusively that there is a definite type of egg production curve in this country.

4. The egg production curve in this country is very similar to those of the United States and Australia, although they do not exactly coincide as to the time of the year.

5. There is sufficient reason to believe that the egg production curve of chickens in this country is perhaps more nearly like the normal egg production curve of the primitive kinds of fowls than curves of egg production observed in the temperate countries.

6. The laying year may be roughly divided into two periods, the reproductive period, January to June, and the rest period, July to December.

7. The reproductive life of a chicken is a succession of the reproductive period and of the rest period, which correspond very closely to the two distinct dry and wet seasons of the year.

8. The annual molt coincides in general with the gradual drop of egg production which begins about July and ends about December.

9. If fowls start in their reproductive processes early in the season, a second or even a third clutch of eggs may be laid during the favorable period of the year.

10. The number of eggs laid by the hens during each of these periods depends upon the age and individuality of the birds, the amount of care given them in feeding, housing, and management, and upon other conditions of the environment.

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TABLE 1

Showing the monthly percentage of egg production of Cantonese chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922–23	1923–24	1924–25	1925–26	1926–27	
September	26.6	23.8	24.7	24.4	20.6	24.02
October	19.5	24.3	27.3	16.9	18.0	21.24
November	12.6	25.0	28.5	26.0	14.1	21.24
December	5.6	25.4	25.4	19.0	22.4	19.56
January	33.2	22.7	36.4	28.9	25.2	29.28
February	35.7	36.5	36.7	31.9	30.0	34.16
March	31.5	32.8	35.9	34.3	30.6	33.02
April	36.2	30.5	32.4	29.4	28.1	31.32
May	28.0	31.2	26.7	26.4	30.1	28.48
June	28.1	28.7	25.1	27.6	25.1	26.92
July	28.8	22.2	27.3	25.5	20.0	24.76
August	26.7	12.7	26.7	17.1	12.9	19.22

TABLE 2

Showing the monthly percentage egg production of Native chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922–23	1923–24	1924–25	1925–26	1926–27	
September	28.0	22.2	21.2	21.2	16.5	21.82
October	17.7	20.9	21.7	26.5	23.4	22.04
November	20.8	15.5	22.8	19.4	16.7	19.04
December	10.8	11.7	28.6	26.9	17.6	19.12
January	21.1	15.1	31.3	29.3	20.3	23.42
February	29.4	33.2	29.6	31.5	29.9	30.72
March	18.8	31.2	36.6	54.4	35.5	35.30
April	20.7	32.3	42.0	35.4	32.5	32.58
May	25.3	26.4	35.0	38.2	36.4	32.26
June	27.1	30.3	31.1	32.8	36.3	31.52
July	28.8	20.5	29.7	30.5	31.3	28.16
August	27.7	17.7	26.5	18.5	23.4	22.76

TABLE 3

Showing the monthly percentage egg production of White Leghorn chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922–23	1923–24	1924–25	1925–26	1926–27	
September	19.8	18.6	5.8	28.4	7.1	15.94
October	15.2	17.7	14.8	18.8	36.7	20.64
November	29.5	16.8	40.7	18.1	43.7	29.76
December	5.5	16.2	38.4	21.4	20.6	20.42
January	24.2	26.1	37.5	37.3	30.8	31.18
February	24.1	37.9	38.6	32.0	37.1	33.94
March	21.9	45.4	34.6	37.9	38.8	35.72
April	24.2	36.6	40.2	33.9	32.5	33.48
May	24.6	35.5	26.2	37.6	38.7	32.52
June	22.1	41.3	39.6	37.3	30.9	34.24
July	29.9	27.7	35.5	32.2	30.2	31.10
August	25.5	27.4	50.7	21.9	27.3	30.56

TABLE 4

Showing the monthly percentage egg production of Barred Plymouth Rock chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922–23	1923–24	1924–25	1925–26	1926–27	
September	28.1	16.3	9.3	17.1	6.8	15.52
October	13.2	18.5	25.6	11.9	23.5	18.54
November	4.6	15.5	41.1	20.0	27.0	21.64
December	9.3	10.0	18.2	5.3	27.4	14.04
January	22.0	21.4	8.6	18.5	26.7	19.44
February	22.1	30.7	35.7	43.2	32.2	32.78
March	24.4	35.5	37.6	36.1	41.6	35.04
April	27.1	30.1	41.2	35.0	32.6	33.20
May	24.6	31.3	38.9	36.8	33.1	32.94
June	21.3	25.9	24.1	35.2	32.1	27.72
July	25.4	28.0	24.1	28.8	30.6	27.38
August	17.7	17.7	12.3	23.7	26.7	19.62

TABLE 5

Showing the monthly percentage egg production of Rhode Island Red chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922–23	1923–24	1924–25	1925–26	*a*	
September	24.4	24.5	2.5	13.6		16.25
October	8.9	12.8	12.2	20.9		13.70
November	10.0	12.6	22.7	25.0		17.57
December	3.4	8.4	20.9	17.6		12.57
January	18.8	5.6	24.3	20.6		17.32
February	22.8	26.8	21.7	29.3		25.12
March	22.1	37.0	25.9	27.2		28.05
April	22.3	32.9	33.3	25.0		28.37
May	17.9	31.9	37.1	27.4		28.57
June	20.0	30.2	30.0	30.0		27.55
July	24.3	30.2	41.9	22.6		29.75
August	25.8	32.7	28.6	14.1		25.30

[a] The data for the laying year 1926–1927 for this breed was excluded as the number of hens in the pen was less than ten.

TABLE 6[a]

Showing the normal egg production of Cantonese, Native, White Leghorn, Barred Plymouth Rock, and Rhode Island Red breeds of chickens expressed in terms of number of eggs expected from each individual each month

MONTHS	NUMBER OF EGGS				
	Cantonese	Native	White Leghorn	Barred Plymouth Rock	Rhode Island Red
September	7.2	6.5	4.8	4.7	4.9
October	6.6	6.8	6.4	5.7	4.2
November	6.4	5.7	8.9	6.5	5.3
December	6.1	5.9	6.3	4.3	3.9
January	9.1	7.3	9.7	6.0	5.4
February	9.6	8.6	9.5	9.2	7.0
March	10.2	10.9	11.1	10.9	8.7
April	9.4	9.8	10.0	10.0	8.5
May	8.8	10.0	10.1	10.2	8.9
June	8.1	9.5	10.3	8.3	8.3
July	7.7	8.7	9.6	8.5	9.2
August	6.0	7.1	9.5	6.1	7.8
Total	95.2	95.8	106.2	90.4	82.1

[a]Computed from averages of percentage egg production given in tables 1 to 5.

TABLE 7

Showing the seasonal distribution of eggs in the Philippines compared with that in Australia (1924) and United States (1924)

MONTHS	PERCENTAGE EGG PRODUCTION		
	Philippines[a]	Australia[b]	United States[c]
September	24.0	56.1*	27.6
October	21.2	55.1	20.8
November	21.2	53.3	17.0+
December	19.6+	47.9	24.8
January	29.3	40.6	34.5
February	34.2*	38.9	51.7
March	33.0	35.4	67.1*
April	31.3	26.9+	66.3
May	28.5	39.5	61.2
June	26.9	50.7	53.6
July	22.8	51.2	43.8
August	19.2	50.2	32.3

[a]Five year average (1922–1927) for the Cantonese breed.

[b]Victoria, 1924 data for the Black Orpington breed.

[c]New Jersey, 1922 data for the Barred Plymouth Rock breed.

* Maximum. + Minimum.

COMPARATIVE NUTRITIVE VALUES OF DIFFERENT SALTS OF AMMONIUM[1]

ELEUTERIO PALISOC

In studying the salt requirements of young rice plants, Espino[2] found that Shive's[3] 3-salt complete culture solution in which nitrogen was employed only as nitrate invariably produced a chlorotic appearance of young rice plants, and growth was stunted, but when ammonium sulfate was added to the culture solution, excellent growth and development of the plants was always obtained. The apparent beneficial effect which the young rice plants derived from the ammonium sulfate makes it of interest to find out what other ammonium compounds may give a similar effect. The object of this study, was to determine the effects of these compounds on young rice plants. It was conducted in the Department of Plant Physiology of the College of Agriculture, during the academic year, 1926-27.

MATERIALS AND METHODS

The young plants

Young rice plants of a lowland variety were used in this study. The seeds were germinated on a piece of paraffined bobbinet stretched horizontally over the wide mouth of a large glass vessel filled to the rim with tap water so that the bobbinet lay on the surface of the water nearly all the time. This level was maintained by frequent additions of water in the vessel.

When the shoot was about six centimeters high, uniformly developed seedlings were selected for the cultures. These seedlings were transferred to the nutrient solutions by fixing each of them in a perforated cork stopper in the manner described by Espino[2]. Each culture had three seedlings,—one seedling to a hole.

The culture solutions

Single-salt stock solutions. The salts used in the cultures were first prepared singly in M/10 concentration. These salts were "Baker analysed" monopotassium phosphate (KH_2PO_4), calcium nitrate ($Ca(NO_3)_2$), mag-

[1] Part of thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture No. 262; Experiment Station contribution No. 529. Prepared in the Department of Plant Physiology under the direction of Dr. R. B. Espino.

[2] Espino, Rafael B. 1920. Some aspects of the salt requirements of young rice plants. Philippine Journal of Science **16:** 455–525.

[3] Shive, John W. 1915. A study of physiological balance in nutrient media. Physiological Researches **1:** 327–397.

nesium sulfate ($MgSO_4$), ammonium sulfate ($(NH_4)_2SO_4$), ammonium nitrate, and ammonium phosphate. Distilled water was used as the solvent of all these salts.

Culture solution. The culture solutions were prepared according to the proportions and concentrations of each salt as shown in table 1. Each solution was prepared in the manner described by Espino [2]. Sixty-five cubic centimeters of each solution were used as a culture medium; it was placed in a glass bottle about eight centimeters high and with a gross diameter of four centimeters. Each culture was run in duplicate for 21 days and renewals of solution were made every three days. Two trials were run for each salt series, except the control series in which four trials were made and three salts series were run simultaneously, so that in a given experimental period there were 54 cultures; 24 cultures for each of the two salt series and six bottles for the control. The culture series may be described briefly as follows:

Ammonium nitrate series. This was a combination of monopotassium phosphate, ammonium nitrate, calcium nitrate, and magnesium sulfate, with ammonium nitrate in varying amounts.

Ammonium phosphate series. This was a combination of monopotassium phosphate, mono-ammonium phosphate, calcium nitrate, and magnesium sulfate, with mono-ammonium phosphate in varying amounts.

Ammonium sulfate series, or control series. This is the so-called Espino's best 4-salt solution type A employed here as control and also as a series of cultures by itself. This is a combination of monopotassium phosphate, ammonium sulfate, calcium nitrate and magnesium sulfate in the proportions of these salts as shown in table 1.

No other salt of ammonium was tried as there was no other that could be used without introducing into the culture medium a non-essential element. For example, ammonium chloride was not used because it would add chlorine to the culture solution.

EXPERIMENTS AND RESULTS

In the ammonium nitrate and the mono-ammonium phosphate series six cultures, (cultures 5 and 6 under groups A, B, and C, see table 1) were not run in the first trial, and another six cultures (cultures 1 and 2 under groups A, B, and C) were not run in the second trial. The reason for this was that in the first trial when the heaviest yield of dry weight of plants was produced by those growing in the highest concentrations in each group, additional solutions of still higher concentrations were run so as to find the optimum concentration for the growth and development of rice plants. Such being the case, the two lowest concentrations in each group run in the first trial that did not seem to be good for the young plants were not included in the second trial, and in their stead in each group, there were carried two concentrations higher than any included in the first trial. The

control cultures, or what may be considered as the ammonium sulfate series, were always included in the other ammonium salt sets.

To determine the relative beneficial effects of the different media upon the growth and development of the young rice plants, the following criteria of results were used:

External appearance of plants. The external appearance of the plants was carefully noted from time to time. The color of the leaves and stalks was noted, together with any injury in any part of the plants. The observations taken at the time of harvest were recorded, and are on file in the Department of Plant Physiology; they are not included in this paper for lack of space.

Measurement of growth. Before harvesting the plants at the end of an experimental period, the full lengths of the roots and the top of each culture were measured separately. The data thus obtained are not here presented, except those for the best culture from each salt series (see table 2).

Dry weights of plants. After harvesting, the plants were wrapped separately by cultures with paper and then dried in an electric oven. Then they were weighed and the data recorded but not here presented, except those for the best culture for each salt series (see table 2).

The control cultures. The results of the best of the control cultures are also recorded in table 2.

DISCUSSION OF RESULTS

In attempting to solve the problems on hand, a substitution method was employed. A radical attached to one metal was substituted for another radical and a metal with one radical was substituted for another metal attached to the same kind of radical in Espino's solution of 4-salt type A. For example, in the ammonium nitrate and the ammonium phosphate series, all the salts in Espino's solution of 4-salt type A were included except the ammonium sulfate, which was replaced by ammonium nitrate in the ammonium nitrate series and by ammonium phosphate in the ammonium phosphate series. Care was taken that in the process of substitution no element essential for the normal growth and development of plants was omitted, nor was an element or elements not included in the 4-salt type A of Espino's solution introduced. The different salt series were first studied separately and the culture solution found best in each series is here used in making the comparative nutritive values.

The cultures in the ammonium nitrate series

Examination of the data, which for lack of space are not here printed, showed that the plants grown in the cultures in the ammonium nitrate series were normally developed. In fact, some of the cultures of this series were better than the control.

Arbitrarily selecting from each of the two trials the cultures that gave the three highest records on: (*a*) the height of top, (*b*) length of root, and (*c*) the weight of dry plants, it was found that primarily under the last criterion of results and supported by the highest record under either or both of the other two criteria, that the culture B-NH_4NO_3-4 was the best in this series. This culture was found to have given the best result in both trials and was characterized by having 1 part KH_2PO_4; 4 parts NH_4NO_3; 2 parts $Ca(NO_3)_2$; and 4 parts $MgSO_4$, with a total concentration of 0.00275 gram-molecule (of all the salts taken together) per liter.

The cultures in the mono-ammonium phosphate series

As shown by the data recorded but not here published, the plants grown in the cultures in the mono-ammonium phosphate series were fairly well developed as to tops and roots and had very dark green leaves and culms, but these plants had leaves with dried tips. This injury was plainly observed on the plants grown in the culture solutions containing the higher partial concentration of mono-ammonium phosphate.

Arbitrarily selecting the cultures from each trial yielding the three consecutive highest yields or records under each of the criteria of results here employed, it was found that the culture B-$NH_4H_2PO_4$-4 gave the best plants in both trials. This culture was characterized by having 1 part KH_2PO_4; 4 parts $NH_4H_2PO_4$; 2 parts $Ca(NO_3)_2$; and 4 parts of $MgSO_4$ with a total concentration of 0.00275 gram-molecule (of all the salt taken together) per liter.

The cultures in the ammonium sulfate (control) series

The data obtained from the three cultures in which ammonium as sulfate was supplied the young rice plants showed that the culture solution made up of one part each of monopotassium phosphate, ammonium sulfate, and calcium nitrate and five parts of magnesium sulfate with a total concentration of 0.002 gram-molecule (of all the salts taken together) per liter was the best. This finding corroborates Espino's results (see footnote) and the data obtained from this culture medium are here used in making the comparative nutritive values of the three forms of ammonium salts.

The best culture from each series compared

The *best* culture from each of the three ammonium salts series tried—the NH_4NO_3–series, the $NH_4H_2PO_4$–series, and the $(NH_4)_2SO_4$–series,—were compared. For this purpose and for the sake of clearness these *best* cultures were compiled from the data on hand and are presented in table 2.

Examination of table 2 shows that in term of the dry weight of the plant, the control, or the best culture from the $(NH_4)_2SO_4$-series was surpassed by the best culture in the NH_3NO-series by at least 25 per cent. This difference indicates that the ammonium ion was more beneficial to the

young rice plants when attached to the nitrate radical than when it was attached to the sulfate radical.

Further, the data in table 2 also show that the phosphate of ammonium was harmful to the young rice plants; for although the plants were apparently fairly well developed in the cultures which contained this salt, yet the leaves were dry at the tips,—a physiological disturbance similar to that observed by Espino when the $Ca(NO_3)_2$ was replaced by the monobasic calcium phosphate, $(Ca(H_2PO_4)_2.H_2O)$ in a complete culture solution (see footnote).

The relative nutritive values of the different salts of ammonium tested may be tentatively be given as follows: NH_4NO_3 was the best; $(NH_4)_2SO_4$ was next best; and the $NH_4H_2PO_4$ was the poorest, or most unsuitable for the young rice plants as this salt always gave a characteristic physiological injury,—drying of the tips of the leaves. The culture solution found best suited for the growth and development of the young rice plants was characterized by having 1 part KH_2PO_4; 4 parts NH_4NO_3; 2 parts $Ca(NO_3)_2$; and 4 parts $MgSO_4$ with a total concentration of 0.00275 gram-molecule (of all the salts taken together) per liter.

SUMMARY OF CONCLUSIONS

Under the conditions of this study, it was found that:

1. Of all the ammonium salts tried, NH_4NO_3 was the best; $(NH_4)_2SO_4$ was next best; and $NH_4H_2PO_4$ was the poorest, as it always produced a characteristic physiological injury,—drying of the tips of the leaves of the young rice plants.

2. A new culture solution nutritively better than Espino's best 4-salt solution type A was found and characterized by having 1 part KH_2PO_4; 4 parts NH_4NO_3; 2 parts $Ca(NO_3)_2$; and 4 parts $MgSO_4$ with a total concentration of 0.00275 gram-molecule (of all the salt taken together) per liter.

TABLE 1

Salt proportions and total concentration of all the salt series

SALT SERIES	CULTURE DESIGNATION	SALT PROPORTION: GRAM MOLECULE OF EACH SALT PER LITER				CONCENTRATION OF CULTURE SOLUTION: GRAM-MOLECULE OF ALL SALTS TAKEN TOGETHER PER LITER
		KH_2PO_4	NH_4NO_3	$Ca(NO_3)_2$	$MgSO_4$	
Ammonium nitrate	A—NH_4NO_3–1	.00025	.000125	.00025	.00125	0.001875
	–2	.00025	.00025	.00025	.00125	0.002
	–3	.00025	.0005	.00025	.00125	0.00225
	–4	.00025	.001	.00025	.00125	0.00275
	–5	.00025	.002	.00025	.00125	0.00375
	–6	.00025	.004	.00025	.00125	0.00575
	B—NH_4NO_3–1	.00025	.000125	.0005	.001	0.001875
	–2	.00025	.00025	.0005	.001	0.002
	–3	.00025	.0005	.0005	.001	0.00225
	–4	.00025	.001	.0005	.001	0.00275
	–5	.00025	.002	.0005	.001	0.00375
	–6	.00025	.004	.0005	.001	0.00575
	C—NH_4NO_3–1	.00025	.00025	.00025	.001	0.00125
	–2	.00025	.0005	.00025	.001	0.002
	–3	.00025	.001	.00025	.001	0.0025
	–4	.00025	.002	.00025	.001	0.0035
	–5	.00025	.004	.00025	.001	0.0055
	–6	.00025	.008	.00025	.001	0.0095
		KH_2PO_4	NH_4H_2-PO_4	$Ca(NO_3)_2$	$MgSO_4$	
Ammonium phosphate	A—$NH_4H_2PO_4$–1	.00025	.000125	.00025	.00125	0.001875
	–2	.00025	.00025	.00025	.00125	0.002
	–3	.00025	.0005	.00025	.00125	0.00225
	–4	.00025	.001	.00025	.00125	0.00275
	–5	.00025	.002	.00025	.00125	0.00375
	–6	.00025	.004	.00025	.00125	0.00575
	B—$NH_4H_2PO_4$–1	.00025	.000125	.0005	.001	0.001875
	–2	.00025	.00025	.0005	.001	0.002
	–3	.00025	.0005	.0005	.001	0.00225
	–4	.00025	.001	.0005	.001	0.00275
	–5	.00025	.002	.0005	.001	0.00375
	–6	.00025	.004	.0005	.001	0.00575
	C—$NH_4H_2PO_4$–1	.00025	.00025	.00025	.001	0.00175
	–2	.00025	.0005	.00025	.001	0.002
	–3	.00025	.001	.00025	.001	0.0025
	–4	.00025	.002	.00025	.001	0.0035
	–5	.00025	.004	.00025	.001	0.0055
	–6	.00025	.008	.00025	.001	0.0095
		KH_2PO_4	$(NH_4)_2SO_4$	$Ca(NO_3)_2$	$MgSO_4$	
Ammonium sulfate (Control)	A	.00025	.00025	.00025	.00125	0.002
	B	.00025	.00025	.0005	.001	0.002
	C	.00025	.0005	.00025	.001	0.002

TABLE 2

Comparing the data obtained from all the "best" cultures [a] (Compiled from data not presented in this paper)

DATE OF EXPERIMENTS	CULTURE DESIGNATION	SALT PROPORTION	HEIGHT OF TOP [b]	LENGTH OF ROOT [b]	WEIGHT OF DRY TOP AND ROOT [b]	EXTERNAL APPEARANCE OF PLANTS
October 21 to November 11, 1926	B—NH_4NO_3–4	1 part KH_2PO_4 4 parts NH_4NO_3 2 " $Ca(NO_3)_2$ 4 " $MgSO_4$	121	126	125	Plants dark green; vigorous; plenty of roots
	B—$NH_4H_2PO_4$–4	1 part KH_2PO_4 4 parts $NH_4H_2PO_4$ 2 " $Ca(NO_3)_2$ 4 " $MgSO_4$	110	124	107	Plants fairly well developed, normal green, tips of leaves dried
	Control	1 part KH_2PO_4 1 " $(NH_4)_2SO_4$ 1 " $Ca(NO_3)_2$ 5 parts $MgSO_4$	100 (58.9 cm.)	100 (24.6 cm.)	100 (.247 gram)	Plants normal
December 10 to December 31, 1926	B—NH_4NO_3–4	1 part KH_2PO_4 4 parts NH_4NO_3 2 " $Ca(NO_3)_2$ 4 " $MgSO_4$	103	102	132	Plants dark green; vigorous; plenty of roots
	B—$NH_4H_2PO_4$–4	1 part KH_2PO_4 4 parts $NH_4H_2PO_4$ 2 " $Ca(NO_3)_2$ 4 " $MgSO_4$	105	98	103	Plants fairly well developed; normal green; tips of leaves dried
	Control	1 part KH_2PO_4 1 " $(NH_4)_2SO_4$ 1 " $Ca(NO_3)_2$ 5 parts $MgSO_4$	100 (66.4 cm.)	100 (28.0 cm.)	100 (.33 gram)	Plants normal

[a] The culture giving the highest yield of dry weight of tops from each trial, or set of cultures is the "best" culture.

[b] The data are in relative values; the highest actual value under each criterion was arbitrarily taken as 100, the other actual values were reduced relatively.

NOTE: INTRODUCED COFFEES LOSE RESISTANCE TO THE RUST FUNGUS HEMILEIA VASTATRIX BERKELEY AND BROOME[1]

PEDRO A. DAVID
Of the Department of Agronomy

The coffee rust-fungus *Hemileia vastatrix* B. and Br. is responsible for the failure of the Arabica coffee in the Philippines. The disease became serious in 1889 and destroyed many coffee plantations in Batangas Province. Just how and when the coffee rust was introduced into the Philippines is not known.

In an effort to obtain rust-resistant coffee for the Philippines Professor C. F. Baker of the College of Agriculture, at Los Baños and Messrs. C. C. Batchelder formerly with the Philippine Government and P. J. Wester of the Philippines Bureau of Agriculture, during the period from 1910 to 1916, introduced into these Islands different varieties of supposedly rust-resistant Arabian, Liberian, and Robusta types of coffee from Java and other countries of the world. Two plants of Kawisari B coffee hybrid, the most rust-resistant so far observed in Java were brought in August, 1927, to the College of Agriculture from Java by Dr. N. B. Mendiola of the Agronomy Department. These plants are now growing well in Doctor Mendiola's private collection. Seeds of Kawisari A and Kawisari D were introduced by Doctor Mendiola in January 24, 1924, but they failed to grow. The varieties introduced into the College of Agriculture are given in table 1.

After these different types of coffee were introduced into the College of Agriculture the work of searching for rust-resistant varieties was begun. It was thought that better results could be obtained by planting the introduced coffees at different altitudes. From 1914 to 1916 experimental plantations were opened at different elevations as given in table 2.

The three experimental plantations were given practically the same field treatment. They were not fertilized. From 1918 to 1926 the Division of Coffee, Cacao and Spices of the Department of Agronomy of this College counted the coffee trees of each type of coffee at different altitudes and examined the leaves of individual plants for rust-infection.

In 1921 all of the Arabica trees in the Plateau Plantation were completely defoliated by the rust while the Robusta and Liberian types did not show signs of infection. From 1923, however, the Liberian and Robusta

[1] Experiment Station contribution No. 530. Received for publication January 12, 1928.

types showed trees infected with *Hemileia vastatrix*[2]. It seems that constant exposure to inoculum for a number of years renders even the highly resistant species or varieties of Coffea susceptible to the rust fungus. The summary of the results of this study is given in tables 3 and 4.

From the work on coffee at this College the following statements can now be made with some degree of certainty:

1. All introduced varieties of coffee belonging to the Arabian, Robusta, and Liberian types are subject to the attack of the coffee rust-fungus *Hemileia vastatrix*.

2. Altitudes from 80 to 450 meters above sea level do not affect the relation of Arabian, Robusta, and Liberian types of coffee to the rust fungus.

3. All coffee trees under shade of madre-cacao (*Gliricidia maculata*), ipil-ipil, (*Leucaena glauca*) and anii (*Erythrina fusca*) are more vigorous in their growth and less affected by the rust than those not shaded. This observation seems to be in accord with those of Fromme[3] who found that *Puccinia coronifera* does not develop on its host in the absence of light; and Mains[4] who reported that the development of *Puccinia coronata* and *P. sorghi* on their hosts is retarded or stopped because of the lack of carbohydrates in the absence of light or of carbon dioxide.

4. The Arabian type is the most seriously infected and the Liberian type the least. When the Robusta, Arabica, and Liberica types are grown side by side the Arabian coffee succumbs first to the rust. Robusta coffees seem to be intermediate between the Arabica and Liberica coffees in their susceptibility to the *Hemileia vastatrix*.

5. Observations at this College show that it is not advisable to extend our college plantings of the imported and supposedly rust-resistant Robusta and Liberica coffees at the present time. The writer noted that a prolonged exposure of these types of coffee to infection render them susceptible to rust and it is believed that sooner or later their fate would be the same as the old Arabian type and careful search for rust-resistant hybrids should now be undertaken.

[2] Determination by G. O. Ocfemia, Department of Plant Pathology.

[3] Fromme, F. D. 1913. The culture of cereal rusts in the greenhouse. Bulletin of the Torrey Botanical Club 40: 501–521.

[4] Mains, F. B. 1917. The relation of some rusts to the physiology of their hosts. Amer. Jour. Bot. **4**: 179–220.

TABLE 1

Types of coffee introduced into the College of Agriculture

Arabian Type

COLLEGE NO.	VARIETY NAME	DATE OF INTRODUCTION	SOURCE OF ORIGIN
27	Rond de Bourbon	June 15, 1910	Vilmorin
144	Caracolillo	August 15, 1910	Nueva Vizcaya
316	Arabica	October 28, 1911	Lipa, Batangas
449	Arabica	November 4, 1912	Calauan, Laguna
642	Arabica	November 10, 1912	Malaybalay, Agusan
730	Arabica	November 25, 1912	Royal Botanic Garden, Calcutta
857	Arabica	December 5, 1912	Porto Rico, Experiment Station
909	Arabica	January 8, 1913	Royal Biological Experiment Institute, Africa
966	Golden Drop	January 13, 1913	Trinidad Botanic Gardens
1433	Sierra Leona	February 15, 1913	Bureau of Education
1506	Arabica	March 13, 1913	Bombay, India
1565	Arabica	April 1, 1913	Port Said Market
1606	Arabica	April 16, 1913	Jamaica
1975	Arabica	September 17, 1913	Blue Mt. Government Botanic Garden La Bagh
1976	Arabica	September 17, 1913	"
1977	Arabica	September 17, 1913	"
2295	Arabica	November 1, 1913	"
2296	Arabica	November 1, 1913	"
2707	Arabica	April 20, 1914	Robert Seth & Company, Calcutta
2776	Arabica	April 23, 1914	Cuba
3145	Arabica	September 18, 1914	Borneo
3146	Arabica	September 18, 1914	Borneo
5427	Arabica	March 19, 1915	Lipa, Batangas
5596	Arabica	March 19, 1915	Maahas, Los Baños, Laguna
5597	Arabica	February 9, 1916	Los Baños, Laguna
5843	Arabica	April 26, 1916	Lepanto, P. I.
6347	Arabica	November 11, 1916	Bukidnon, P. I.
6612	Arabica	February 15, 1917	Los Baños, Laguna
17290	Arabica	August 9, 1921	Bureau of Agriculture

Robusta Type

1450	Bukobensis	February 18, 1913	Africa
1650	Robusta	May 8, 1913	Trinidad, P. I.
2037	Canephora	September 26, 1913	Buitenzorg, Java
2038	Robusta	September 24, 1913	Buitenzorg, Java
2039	Ugandae	September 24, 1913	Buitenzorg, Java
2040	Quillou	September 24, 1913	Buitenzorg, Java
2041	Congensis	September 24, 1913	Buitenzorg, Java
2704	Robusta	April 20, 1914	Calcutta
2705	Ugandae	April 20, 1914	Calcutta
4542	Deweorci (L)	August 19, 1915	Bureau of Agriculture
5484	Ugandae	December 17, 1915	Bureau of Science
5485	Quillou	December 17, 1915	Bureau of Science
5486	Robusta	December 17, 1915	Bureau of Science
5487	Robusta	December 17, 1915	Bureau of Science
5488	Congensis	December 17, 1915	Bureau of Science
5489	Robusta	December 17, 1915	Bureau of Science
5490	Ugandae	December 17, 1915	Bureau of Science
5492	Robusta	December 17, 1915	Bureau of Science
5493	Canephora	December 17, 1915	Bureau of Science
5494	Madagascariensis	December 17, 1915	Bureau of Science
5495	Robusta	December 17, 1915	Bureau of Science
5496	Robusta	December 17, 1915	Bureau of Science
5581	Robusta	January 31, 1916	Bureau of Agriculture
6888	Deweorci (L)	December 5, 1916	Buitenzorg, Java

6611	Dewvorei (L)	February 15, 1917	Porto Rico
6679	Robusta	May 11, 1917	Porto Rico

Liberica Type

965	Liberica	January 13, 1913	Botanic Garden, Trinidad
1553	Deweorci	March 26, 1913	Buitenzorg, Java
1554	Dybowskii	March 26, 1913	Buitenzorg, Java
1555	Abeokutae	March 26, 1913	Buitenzorg, Java
1556	Excelsa	March 26, 1913	Buitenzorg, Java
1558	Excelsa	March 26, 1913	Port Said Market
1865	Liberica	August 13, 1913	Singapore
1874	Liberica	September 9, 1913	Calcutta, India
2706	Liberica	April 20, 1914	Calcutta, India
5426	Liberica	August 5, 1915	Lipa, Batangas
5491	Excelsa	December 17, 1915	Bureau of Science, Manila
5580	Excelsa	January 31, 1916	Bureau of Science, Manila
5582	Abeokutae	January 31, 1916	Bureau of Science, Manila
5858	Liberica	May 13, 1916	Lipa, Batangas
6108	Liberica	September 5, 1916	Lipa, Batangas
6109	Liberica	September 5, 1916	Lipa, Batangas
6110	Liberica	September 5, 1916	Lipa, Batangas
6177	Liberica	September 18, 1916	Lipa, Batangas
6178	Liberica	September 18, 1916	Lipa, Batangas
6389	Excelsa	December 5, 1916	Buitenzorg, Java
6390	Abeokutae	December 5, 1916	Buitenzorg, Java
6613	Abeokutae	February 17, 1917	Porto Rico
8117	Liberica	February 4, 1918	Lipa, Batangas
8511	Liberica	March 20, 1918	Lipa, Batangas
8512	Liberica	March 20, 1918	Lipa, Batangas
8513	Liberica	March 20, 1918	Lipa, Batangas
8514	Liberica	March 20, 1918	Lipa, Batangas
8515	Liberica	March 20, 1918	Lipa, Batangas
8573	Liberica	March 20, 1918	Lipa, Batangas
8574	Liberica	March 20, 1918	Lipa, Batangas
18092	Dybowskii	January 24, 1924	Java
18093	Arnoldiana	January 24, 1924	Java

Hybrid

18090	Kawisari A	January 24, 1924	Buitenzorg, Java
18091	Kawisari D	January 24, 1924	Buitenzorg, Java
	Kawisari B	August 23, 1927	Buitenzorg, Java

TABLE 2

Showing elevations and annual rainfall at the different altitudes where the three types of introduced coffee were planted

PLANTATION	ELEVATION	AVERAGE ANNUAL RAINFALL[a]	NUMBER OF TREES PLANTED		
			Arabica	Robusta	Liberica
	meters	*mm.*			
Mount Maquiling	450	2619.2	464	490	111
Plateau	100	2139.7	1600	7301	100
College Farm	80	2139.7	200	284	38

[a]The record of the rainfall was obtained from the Department of Plant Physiology, College of Agriculture. The rainfall on Mount Maquiling is an average obtained for 1918 to 1921. The rainfall on the Plateau and College Farm is an average for 1918 to 1926.

TABLE 3

Showing a summary of yearly observations from 1918 to 1926 on the relation of different varieties of coffee at different altitudes to infection by Hemileia vastatrix

TYPES	PLANTATION	NUMBER OF TREES STUDIED		PERCENTAGE OF INFECTED TREES
		Affected	Not affected	
Arabian	Mount Maquiling	441	23	95.0
Robusta	Mount Maquiling	431	59	88.0
Liberica	Mount Maquiling	12	99	10.8
Arabian	Plateau	1600	00	100.0
Robusta	Plateau	584	6717	8.0
Liberica	Plateau	00	10	0.0
Arabian	College Farm	200	00	100.0
Robusta	College Farm	142	142	50.0
Liberica	College Farm	4	35	10.3

NOTE:—Observations were made during the latter part of September and early part of October.

TABLE 4

Showing the relation of the different varieties of coffee at different elevations to infection by Hemileia vastatrix in 1927

TYPES	PLANTATION	NUMBER OF TREES STUDIED		PERCENTAGE OF INFECTED TREES
		Affected	Not affected	
Arabica	Mount Maquiling	8	0	100
Robusta	Mount Maquiling	26	13	67
Liberica	Mount Maquiling	32	22	59
Arabica	Plateau	dead	dead	dead
Robusta	Plateau	2017	576	78
Liberica	Plateau	70	15	82
Arabica	College Farm[a]	11	0	100
Robusta	College Farm	285	80	78
Liberica	College Farm	64	108	37

[a]Replanting was made on the College Farm.

NOTE:—Observations were made during October and November.

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Prof. Inocencio Elayda

A Popular Cover Crop

Cover cropping is not a very old practice in the Islands. In fact there is hardly any plant in the Philippines which may be called an ideal cover crop. At present a plant supposed to have come from Java several years ago is attracting the attention of farmers. The scientific name of the plant is *Tephrosia candida*, but it is popularly known as Teprosia. The plant though essentially a cover crop is being used in several ways. Since it is a legume it is used very effectively as a soil renovator especially in sugar cane districts. It is used in the eradication of cogon in coconut plantations and at the same time it serves as a cover crop for the coconuts. Teprosia has been proved to be a very excellent cover crop for orchards, especially for citrus. Actual results of its effectiveness as a cover crop for citrus can be seen in the Tanawan Citrus Experiment Station. Recently, it has been found in Batangas that it can be used as a cover crop and at the same time a temporary shade for coffee. So with the agitation for the revival of the coffee industry in Batangas which is attracting the attention of the local press, the use of Teprosia as a shade is always linked. There is a very great demand for seeds.

The popularity of Teprosia is owing to its several good qualities. It is a very fast grower. It is not eaten by farm animals. It is very robust, so it kills the weeds growing under it. It grows to an ideal height for a shade and for a cover crop. Its wood is not hard as is the ipil–ipil so that it can be cut very easily when it is no longer needed. It is very easy to grow. And lastly it produces seeds in great quantities. Such qualities adapt it to Philippine conditions.

Provincial Carnivals

At the present writing two of the wealthy provinces of the Philippines, Laguna and Occidental Negros are holding provincial carnivals. The one in Laguna is in San Pablo, and that of Negros in Bacolod. The holding of such carnivals ought to be encouraged, because they are places of amusement and at the same time have some instructional value. The authorities concerned should be more interested in the serious objects of the carnival, promotion of agriculture and sanitation. If managed properly it should be a means by which business and agricultural enterprises could be promoted. It should not be a display only of beautiful ladies of the province, but rather an exposition of what the province has done, will do, and is doing to promote economic development.

A Successful Farm Demonstration

A few weeks ago a demonstration was held in Pila, Laguna of a threshing machine taken from the College of Agriculture. Professor Raymundo of the College demonstrated the efficiency of the threshing machine in threshing rice as compared to the native method. The people of Pila were very satisfied with the machine. Professor Raymundo says he would not be surprised to find a similar machine in operation in Pila next year. The people found that the machine was really a labor-and-money-saving device. The capacity of the machine a day is equivalent to the work of fifty men. The expenses incurred by using the machine is only about half as much as when human labor is used.

BE THE BEST OF WHATEVER YOU ARE

If you can't be a pine on top of the hill
Be a scrub in the valley—but be
The best little scrub by the side of the rill,
Be the bush if you can't be a tree;
If you can't be a bush be a bit of the grass
Doing something for somebody's sake;
If you can't be a muskie then just be a bass,
But the liveliest bass in the lake.
We can't all be captains, some have to be crew.
There's something for all of us here,
There's big work and little for people to do,
And the task we must do is the near.
If you can't be a highway then just be a rail,
If you can't be the sun be a star.
For it isn't by size that you win or you fail—
Be the best of whatever you are.

—Douglas Malloch.

Nature is ever making signs to us, she is ever whispering to us the beginnings of her secrets; the scientific man must be ever on the watch, ready at once to lay hold of nature's hint, however small, to listen to her whisper, however low.

—M. Foster.

EXCHANGE NOTES

Very recently eighteen master farmers in the state of Oklahoma were feted at a dinner given in their honor in the capital city of that state. These were men who had been nominated by their neighbors and chosen by appointed judges as exemplars to the farmers of the country. In becoming members of this select group, which numbers more than 200 throughout the country, the work of these men as farmers had to pass critical inspection; the general appearance of their farms and buildings, the preparation and upkeep of the soil, the housing and general care given their implements, their business methods, and the home life of their families and their standings in their respective communities were given merciless examination. When admitted to this group, each one had reason to feel justly proud of the honor thus conferred upon him.

—*Butter, Cheese & Egg Journal* (Wisconsin).

Art Meyers, Valley county, Nebraska, grows 100 acres of popcorn annually. The most difficult task, husking, is handled by a mechanical corn picker. Mr. Meyers' machine is drawn by a tractor and shucks 7 to 9 acres a day.

It costs no more to grow an acre of popcorn than of field corn, according to Mr. Meyers and the returns usually are much better. One year he had 250 acres which yielded well and the price was 7 cents a pound. The crop brought $28,000. He grows one half of the baby rice variety and one half of the big rice variety. The baby rice yields less but brings a higher price. Meyers is using alfalfa and sweet clover in keeping his popcorn soils fertile.

—*Capper's Farmer* (Kansas).

If we had paid no more attention to our plants than we have to our children, we should now be living in a jungle of weeds.—Luther Burbank.

—*Journal of Education* (Wisconsin).

According to a recent press report, the problem of commercial utilization of maizestalks is believed to have been solved after many years of effort. The process of Dr. Bela Dorner, a Hungarian chemist, has been brought to the United States, tested by experts, and pronounced practicable and economical. By this method artificial silk has been produced from maizestalk pulp. The technical obstacles have been the pith and knuckle of the stalks, which could not be removed economically. The Dorner process grinds up the entire stalk, which means that it is possible to convert a waste material into abundant supplies of pulp for making paper, artificial

silk, motion-picture films, explosives, celluloid, lacquers, artificial leather, pyralin, and other products. Now the maize belt farms destroy annually more than enough stalks to supply the pulp requirements of the United States. By-products of the Dorner process can be used in the manufacture of alcohol, cattle feed, butanol, furfural, lactic acid, &c. These by-products will be an additional revenue.

—*The Journal of Agriculture,* Australia (Victoria).

The whole endeavour of the farmer to-day is to produce, and to breed with that object in view. It is impossible to dissociate these two things—breeding and feeding. When animals are bred up to heavy production they must be fed in proportion to their capabilities. In order to exhibit their abilities the best of milk-producers require the feed to convert into milk. The same principle applies to pigs. No matter from how economical a strain they may be they will never fatten if not adequately fed. Domesticated farm-stock are living machines, converting vegetable materials (chiefly) into food suitable for human consumption. The more they are expected to give, the more and richer the crude products fed to them must be. Farm-stock convert food unsuitable for human consumption into suitable food.

—*Journal of Agriculture* (New Zealand).

Growers of pineapples in Hawaii have suffered in recent years by the fruits falling off in flavour on some of the plantations. Scientific examination led to the belief that the cause was a deficiency of manganese; additions of manganese salts were therefore made, and the trouble is said to have been in great part remedied.

—*Agricultural Gazette* (New South Wales).

***"Wherever production exceeds consumption, there is progress; where consumption exceeds production, there is retrogression." In New England, each generation has left the country richer than it found it.

—*The American Review of Reviews* (New York).

The most economical source of nitrogen for cornbelt conditions is that obtained through the growth of legumes. Since legumes alone are powerless to add nitrogen to the soil but must have the help of friendly microbes which live in the nodules on their roots, it is apparent that care should be taken to insure the growth of inoculated legumes on the land.

An acre of soybeans will fix as much nitrogen as is contained in eight tons of stable manure.

—*Prairie Farmer* (Illinois).

In the five years from 1920 to 1924 nearly 10,000,000 orange trees were planted in Florida, where the number of trees bearing fruit in 1924 numbered only 7,306,000.

—*Journal of Agriculture* (Victoria).

COLLEGE AND ALUMNI NOTES

Mr. Shunzo Takano, entomologist of the Sugar Experiment Station, Shinkwa, Formosa, recently came to the College. He is intending to stay four months, for the purpose of rearing and introducing into Formosa the tachinid parasites which Doctor Uichanco had reported on *Laspeyresia schistaceana* Sn., one of the most important moth borers of the sugar cane in southern Luzon.

Doctors M. L. Roxas, N. B. Mendiola, R. L. Pendleton, and L. B. Uichanco were invited to read papers at the Planters' Day meeting on April 12, 1928, one of the special features of the Negros Carnival. Doctors Roxas and Uichanco were the only ones of the four able to accept the invitation.

Assistant Professors Margaret Wilson and Marcia Whipple of the Department of English sailed in April for the United States via Europe. Miss Wilson will enter the University of Wisconsin for graduate study in September. She will also carry some classes as instructor in English in the same institution.

On April 3, 1928, at the request of Regent Arturo Garcia, Dr. R. B. Espino went to Santa Cruz, Zambales, to make an agricultural survey of the island "Hermana Mayor" recently acquired by purchase by Doctor Garcia. Doctor Espino returned to the Campus on April 6, 1928. Commenting on this survey, Dean Gonzalez said, "It seems to me this is the kind of extension best fitted for the College—for people to solicit our services rather than for us to "fire" them at them. The first is appreciated; the second is not, most of the time."

During the College year 1927-1928 twenty-two scientific papers were read before the Los Baños Biological Club. These papers were grouped as follows:

Agricultural Economics	1
Agronomy	7
Animal Husbandry	3
Chemistry	2
Entomology	2
Plant Pathology	1
Plant Physiology	2
Veterinary Science	4

Dr. R. B. Espino was elected President and Dr. Valente Villegas secretary of the Club for the College year 1928-29.

The College of Agriculture Class of '28 numbers 49.

The Degree of Bachelor of Agriculture

(General Curriculum)

Anselmo Agbanlog, Balungao, Pangasinan
Gregorio Albino, San Pablo, Aliaga, Nueva Ecija
Amado A. Andrada, Carles, Iloilo
Julian A. Belo, Capiz, Capiz
Lucio Blanco, Bangued, Abra
Catalino Buligan, Tubigan, Bohol
Melanio Calinisan, Mendez, Cavite
Felipe Cortez, Milagros, Masbate
Juan B. Fandiño, Alaminos, Laguna
Eliseo V. Hernandez, Paombong, Bulacan
Filemon Leus, Tanauan, Batangas
Domingo Limbo, San José, Batangas
José R. Mozo, Tarangnan, Samar
Ramón C. Ordoveza, Santa Cruz, Laguna
Lorenzo G. Paderna, Peñaranda, Nueva Ecija
Feliciano Pantaleon, San José, Nueva Ecija
Juan Pegiña, Indang, Cavite
Hermenegildo G. Protacio, Pasay, Rizal
Sisenando Reantaso, Oas, Albay
Dominador Z. Rosell, Alfonso, Cavite
Rafael B. Rotor, Santa Mesa, Manila
Baldomero C. Salinas, Manaoag, Pangasinan
Sixto Sison, Taal, Batangas
Francisco G. Toribio, Carmen, Bohol
Teodoro M. Velasco, San Carlos, Pangasinan
Gaudencio A. Ventura, Mangaldan, Pangasinan
Felix Foranil Villa, Indang, Cavite

The Degree of Bachelor of Science in Agriculture

(General Curriculum)

Roberto C. Betia, Iloilo, Iloilo
Salvador Bolivar, Batan, Capiz
Ignacio Carulla, Natividad, Pangasinan
Moises P. Castro, Concepción, Tarlac
Felix G. Gines, Narvacan, Ilocos Sur
Marcelo B. Peña, Tabaco, Albay
Teodoro N. Pepito, Lilo-on, Cebu
Roem Purnariksha, Bangkok, Siam
Angel H. Severino, Silay, Occidental Negros
Charuña Suebsaeng, Pattani, Siam
Charas S. Sundarasinha, Bangkok, Siam
Simplicio Tiglao, Mabalacat, Pampanga

The Degree of Bachelor of Science in Agriculture
(Supplementary Curriculum)
Tomás Bandong, B. Agr., San Carlos, Pangasinan
Valeriano C. Calma, B. Agr., Bacolor, Pampanga
Mateo D. Jimenez, B. Agr., Talavera, Nueva Ecija
Emilio M. Macasaet, B. Agr., Lipa, Batangas
Zósimo T. Montemayor, B. Agr., Alaminos, Pangasinan
José C. Ramos, B. Agr., Hagonoy, Bulacan

The Degree of Bachelor of Science in Agriculture
(Sugar Technology Curriculum)
Ernesto R. Montinola, San Enrique, Occidental Negros
Delfin Suerte, Santa Barbara, Iloilo

The Degree of Bachelor of Science in Sugar Technology
Atanacio S. Hizon, San Fernando, Pampanga
Ernesto R. Montinola, San Enrique, Occidental Negros

The Class '25 medal for Best Thesis was awarded to Catalino Buligan. His thesis was on "The Corn borer *Pyrausta nubelalis* Hübner." It was prepared under the direction of Dr. L. B. Uichanco.

The Secretary for the College of Agriculture reports on April 10, 1928, as follows on the Summer Session:

	Enrollment	
	1927	*1928*
Old students	308	244
New students	34	34
High School graduates	(13)	(11)
Intermediate School graduates	(21)	(23)
Cross registrants, College of Veterinary Science	(8)	(6)
Special poultry husbandry course	14	8
Total	356	286

Enrollment for Summer Sessions from 1921-28 1921, 200; 1922, 299; 1923, 357; 1924, 366; 1925, 306; 1926, 294; 1927, 356; 1928, 286.

Mr. Bousman, Student Pastor, Union Church and Mr. Tongko, "Y" Secretary, provided a series of lively, entertaining evenings for the students during the week of registration for Summer School. As a leader into the serious work of the summer, the last evening was a lecture on Japan illustrated with stereopticon views.

A Literary Reading Circle among the graduate assistants has been formed. This group meets every fortnight for the purpose of reading aloud and discussing books and articles, serious or otherwise, that are in no way connected with their professional work. There are about twenty members. They meet quite informally: the object being to maintain and cultivate interest in literature of the present day and the past.